DOCUMENT RESUME

ED 258 813 SE 045 809

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TITLE Cooperative Developmental Energy Project. Final Report of Phase I.
INSTITUTION Tennessee State Univ., Nashville. Div. of Continuing Education.
SPONS AGENCY Department of Energy, Washington, DC. Office of Minority Economic Impact.
REPORT NO TSU-0046(A)-16c-533102
PUB DATE Jul 84
NOTE 146p.
PUB TYPE Reports - Descriptive (141)

EDRS PRICE MF01/PC06 Plus Postage.
DESCRIPTORS Careers; *Employment; Employment Opportunities; *Energy; *Energy Education; Females; *Industry; *Minority Groups; *Personnel Policy; Program Descriptions; School Business Relationship
IDENTIFIERS *Tennessee

ABSTRACT

This report provides a summary and description of the activities performed during Phase I (August 1983 to July 1984) of the Cooperative Developmental Energy Project of Tennessee State University. The major intent of the project was to develop a plan of action for enhancing employment and career mobility of minorities in the energy industry. Organizational components and procedural tasks of the project are explained. A review of the probable reasons for low levels of minority employment in the energy industry as well as suggestions for removing the obstacles are provided. A plan of action for Phase II is presented and a listing of activities for the 1984/85 academic year and a schedule for the proposed projects are given. Data and related information occur in eight appendices in the report. Appendix topic areas include: (1) employment of professional and management occupations in energy-related industries; (2) policy implications of personnel employment in energy-related occupations; (3) employment obstacles for minorities in energy-related industries; (4) steering committee minutes; (5) proposal for a Center for Energy Education; (6) cooperative agreements between graduate students and energy-related industries; (7) Energy Education Consortium Paper; and (8) a paper on developing a testing facility. (ML)

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Energy Education Institute

COOPERATIVE DEVELOPMENTAL

ENERGY PROJECT

FINAL REPORT

OF

PHASE I

JULY, 1984

Submitted to the

Office of Minority Economic Impact

Department of Energy

by

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DISCLAIMER

While the Steering Committee helped the author of this report in gaining access to information, analysis of data, and deliberating about different parts of this document, the responsibility for the proposals and ideas of the final report rests solely with the Director of the Cooperative Developmental Energy Project who authored this report. The opinions and positions expressed in this document do not necessarily reflect the opinions of any single member of the committee or any of their respective organizations.

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COOPERATIVE DEVELOPMENTAL ENERGY PROJECT: PHASE I

FINAL REPORT

Introduction

Tennessee State University (TSU) entered into a contractual agreement with the U.S. Department of Energy (DOE) in August 1983 to develop a plan of action for enhancing employment and career mobility of minorities in the energy industry. This report summarizes the findings and describes the activities that took place during Phase 1 of the project from August 1983 to July 1984. It provides an assessment of the various alternatives to pursue in order to meet the project's goal. The report concludes with a set of proposed activities for Phase II.

The contract with the sponsor specifies several task to be completed during Phase I. The identification of data about the industry and its implications (Task 2) are provided in Appendix I and Appendix II. The barriers to minority employment are discussed starting on page 5 and in Appendix III (Task 3). An assessment of the financial requirement (Task 3(b)) starts on page 14. Networking principles (Task 3(c))are proposed on pages 10-12. Tasks 3(d) and 3(e) are dealt with in pages 13-17. Task 4 is present in the University's plan of action for next year, beginning on page 17.

Organization of the Project and General Approach

The project was administratively located within the Division of Continuing Education, Extension, and Public Service at TSU for several reasons. First, the Division had previously conducted energy workshops for teachers and was recognized as a location for energy-related educational activities involving local and state agencies, as well as various segments of the energy industry. Second, the project clearly falls in line with the public service mission of the University, making the Division a natural manager for such activity. Third, the University avoided the undesirable possibility that the project would be identified with any single academic discipline or school. The placement of the project within the Division of Continuing Education allowed easier access to funding opportunities and industry contacts for all the academic schools and their administrative sub-units. The Division provided the project with administrative support and the organizational expertise needed for planning the Energy Career Symposium.

At the earliest stage of its development, this project involved all the organizations and the publics that might be influenced by planned activities. The President of the University appointed a Steering Committee to serve in an advisory capacity and to provide a liaison between the project and other organizations. The Committee was chaired

by the Tennessee Commissioner of Labor and it included the state's Deputy Commissioner of Employment Security, the state Director of High Technology Development, the Deputy Commissioner of Economic and Community Development, the vice presidents of the local gas and electric utilities, the regional director of Shell Oil Co., the district administrator for TVA, the mayor's assistant for minority and small business, a former aide to the mayor in the area of community and neighborhood affairs, and the immediate past-president of the local chapter of the NAACP. Each of those members contributed individually, as well as through participation in the Steering Committee, to the development and implementation of the first phase of the project. Members of the Committee reviewed the plans for the project and participated in group discussions to identify the most promising avenues for action. In addition, each member facilitated access to other individuals, groups, or organizations for support and cooperation. Members made valuable suggestions and provided important feedback to the project director. The state's Legislative Black Caucus endorsed the general approach and purpose of the project in a resolution at its annual retreat in Chattanooga in the fall of 1983. Though symbolic in nature, the early support of this body, as well as the support of some prominant leaders of the black community in Nashville, helped to establish the credibility of the effort.

As a result of the discussions with the Steering Committee and the Office of Minority Impact at the Department of Energy, the major thrust of Phase I evolved around two major efforts:

1. Identification of the main reasons for low level of minority employment in the energy industry and the possible ways to deal with each of them.

2. Involvement of faculty and students in energy-related research or training in cooperation with the industry.

To facilitate the different activities under the two efforts, the project director commissioned two studies. One identified the relevant data about employment in professional and management occupations in energy-related industries (attached as Appendix I and Appendix II). The second study concentrated on obstacles to the promotion of women and minorities in energy-related industries (Appendix III). These two research activities developed in-house expertise and first-hand knowledge among the faculty. This expertise was later used to facilitate the roundtable discussions during a symposium on minority careers in energy. This symposium was organized to meet the project's first task of identifying the reasons for low minority employment in the managerial and professional ranks in the energy industry and the possible ways of dealing with each of them. To fulfill the second task of increasing

involvement by TSU faculty and students in energy-related research and training, a series of discussions were inititated. University officials discussed the development of a proposal for enhancing energy-related activities on campus for students. In addition, negotiations were held with officials of energy-related companies to develop agreements that would allow students and faculty to pursue internships, research, and training opportunities with those companies. The different activities under the two efforts shaped the work plan for the second phase, as will be discussed in more detail below .

Minority Careers in Energy Symposium: Barriers to Minority Employment

On Friday February 24, 1984 more than two hundred individuals gathered at the Downtown Campus of TSU to explore the reasons for low levels of minority employment in the energy industry and to find out what can be done to overcome those obstacles and how universities can actively improve the situation. The conference allowed community leaders and TSU students to find out what kinds of careers and employment are available or may be available in the future in the main sectors of the energy industry: gas, oil, coal, and electric power. The national trade associations sent representatives that gave participants a birds-eye view of where each sector of the industry is and an assessment of future developments in employment and

career mobility. Community leaders, university officials, and students were able to find out where the jobs are , what kind of preparation is needed to qualify for such jobs, the procedures for job application, and the appropriate addresses for contacting prospective employers. Energy-related companies set up corporate displays describing their different commercial activities and distributed printed materials on their affirmative action and general employment programs. Corporate representatives were on hand to answer questions and provide other information. The symposium provided the representatives of the industry with a neutral forum in which to discuss with community leaders, students, and faculty the obstacles to greater minority employment in energy. Participants joined one of four discussion groups representing the four main energy sectors--gas, oil, coal, and electricity. Each discussion group was organized as a round table with a faculty member from TSU as a moderator. All four groups focused on the same discussion questions -- What are the obstacles to minority employment? What can be done to overcome those obstacles? How can TSU and other universities assist in creating change?

In most cases, the discussions confirmed that most students and community leaders were not aware of the various skills needed in the different sectors of the energy industry. There is a general lack of adequate information about the kinds of jobs available. In fact, the

participants were not aware of the most salient occupations in each segment of the industry. The main obstacle to minority employment, therefore, seems to be this lack of information about career opportunities in the energy industry and of the basic skills necessary to prepare for them.

Many minorities lack the particular skills needed to qualify for jobs in the energy industry. While this second obstacle is not completely independent of the first one, it may mean that even when minorities become aware of a possible career in energy, they cannot qualify for the positions. There is clearly a need to offer opportunities for skills development to better prepare minorities for employment.

Since minorities were not traditionally employed in various occupations in the past due to illegal discrimination in employment or education, there is no conceptual background which may lead to an interest in learning about the kinds of careers that may be available in the energy industry or for preparing for them. There is very little involvement of minorities in the coal industry, for example, where sons usually follow in the footsteps of their fathers, brothers, uncles and cousins into the mines. Minorities have no cultural tradition to follow in this field, which presents a third obstacle for them.

Low turnover of employees with utility companies forms a fourth obstacle. Only a few new employees are hired each year. Even fewer minorities are being hired each year. The projected growth in energy use will not result in a proportionate growth in the labor force. Moreover, when an opening occurs, the utility companies tend to hire new employees through the labor union either from habit or because of a contractual obligation. In addition, when vacancies occur due to retirement or transfer, hiring from within and upgrading the skills of those who are already employed further reduces the chances of minorities to start a professional career. Minorities usually enter the corporate ladder only at the bottom rung, even though they may have the formal education, the skills, and the minimum experience required for filling higher-level positions.

Cooperative programs between historically black colleges and universities and the energy industry are rare. Such joint efforts in the area of research and training and the regular exchange of personnel was identified as an important factor in creating student interest in particular careers. The inaccessibility of cooperative programs for minority students forms the fifth obstacle to minority employment in the energy industry. In addition, because such programs are rare, the academic planning of such institutions does not involve specific consideration of the knowledge and manpower needs of the energy industry . There is no concerted effort to advise students and to provide the

kind of courses that can prepare them for employment in the energy industry.

High school teachers and guidance counselors also lack an awareness of energy-related careers. They cannot provide adequate career advising prior to the college level. This sixth obstacle prevents students from pursuing the training or college education necessary for management and professional jobs in energy.

Minority students are not well prepared with job search skills. They do not know how to request applications, how to fill them out, how to write a job resume, or how to prepare for a job interview. Minority applicants may fail to impress a prospective employer with what they can contribute to the organization, even when well qualified, presenting a seventh obstacle to employment.

The eighth obstacle is that most of the industry remains unaware of the existence of obstacles for minorities and they fail to initiate programs to change or to remove them. Many companies wait for the qualified minority applicant to come knocking on the door but may do little to encourage bright young people to prepare for such careers.

False or unrealistic expectations about the nature of employment in the energy industry forms a ninth obstacle. Some new recruits expect to become high level executives overnight or assume that most of the work is done in the office. They have no realistic view of the nature of the

work they have been hired to do. Some university graduates do not expect jobs that involve fieldwork, odd hours, or physical strain. They may not stay long enough with a company to get promotions and to develop a career if their expectations are inconsistent with the reality of the initial experience.

Because only a small number of minorities are employed by the energy industry at present, it is difficult for minority applicants to use the sponsoring or networking techniques possible in other fields. The lack of good personal and professional connections then is a tenth obstacle.

Toward a Plan of Action: What can be done to deal with obstacles to minority employment?

Participants in the symposium and members of the steering committee identified several promising alternatives to deal with some of these obstacles, but little is likely to change overnight. A systematic effort, however, involving all the concerned parties -- governmental agencies, the industry, the community, and the educational system -- may generate a change in the desired direction.

Several of the obstacles to minority employment in the energy industry result from insufficient knowledge about the employment opportunities available or from inadequate preparation for such work. Clearly, students and faculty need activities to inform them about the various jobs and the necessary skills to prepare for such jobs. Since in many cases in is too late to start such preparations in college, special efforts should be made to assist high school students and counselors realize the nature of the available careers in energy and the necessary courses that should be taken to qualify for them.

Cooperative education arrangements, field projects, and internships for students while they are still in school could overcome the problems of unrealistic expectations of jobs and the lack of connections and sponsorship within the industry. Such activities may provide minority students with a better feel for the different employment

opportunities in energy, as well as with the necessary references and connections helpful in job placement. While the University cannot directly effect this need for early experiences, it can promote the idea through various other programs at the University which involve elementary and secondary teachers, principals, and superintendants. In addition, it can provide special weekend and summer institute programs in science and mathematical areas for aspiring elementary and high school students.

Joint projects involving members of the industry and university professors may facilitate the necessary dialogue between historically black universities and the industry to influence academic planning in order to meet the industry's manpower and research needs. Such efforts would better disseminate information about the industry, generate interest among students to consider employment in this sector, and identify promising candidates for employment. This interaction between the University and the energy industry should be carried out on a continuing basis to maximize the potential of institutionalizing energy-related research and training as a "regular" activity on campus.

The industry should make a concentrated effort to identify new areas or occupations where manpower shortages or needs may be expected. The industry should reach out to work with historically black universities in developing appropriate curriculum and career counseling to prepare minority students for employment in the field. Joint

efforts may prove to be beneficial to the industry, the community, and academia in such projects as environmental protection technology.

Historically black universities should make an attempt to promote and coordinate energy education activities on campus to encourage both faculty and students to develop an interest in this industry. The Energy Career Symposium serves as an example of this type of promotional activity.

The University should conduct regular workshops on the preparation of vitas, the completing of employment applications, and the communication skills needed for successful interviews. Such training may be offered as a public service to minority applicants, regardless of whether they are enrolled in the University in order to increase minority presence at all levels of employment. Such efforts may be conducted in cooperation with state and local agencies that deal with employment and community development.

The industry should develop adequate procedures for using the services of the state's Office of Employment Security to identify the most promising candidates to fill vacancies on the basis of tests or other professional assessments to insure that the person will stay with the company and have a successful career.

Assessment of Financial Requirements

Since it is unrealistic to expect that minority students will be able to pull themselves up by their own bootstraps to overcome most of the barriers identified in this report and the attached appendices, the responsibility for mobilizing the necessary resources to overcome such barriers must lay with the government and the industry. Cooperative action of government and industry will provide adequate funding to facilitate increased minority employment in the energy field. A plan of action which does not involve meaningful contributions by the industry from its inception is not likely to survive long nor would such a program ever become independent of major assistance from local, state, and federal sources. Yet, industry is not likely to make radical changes in its funding practices before seeing tangible proof that the proposed plan of action is capable of producing the desired results.

In Phase II, industry should be ready to come forward with some resources to facilitate various components of the proposed plan while the government agency continues to support the plan as it is gathering momentum. This is the approach explained by Mr. Isiah Sewell from DOE at a meeting with the Steering Committee in January 1984 (minutes of the meeting are attached as Appendix IV). In each arrangement with industry, the major costs will be underwritten by the industry. For example, in the

internship experiences, the sponsor will pay interns a meaningful salary for their efforts, with a possible marginal supplement (or a direct subsidy to the sponsor) from government sources, not exceeeding 25% of the total package for the student. This would prevent the unacceptable practice of using minority students as a source of cheap labor and would demonstrate the worth of the sponsor's contribution.

In addition to the necessary funds for developing and operating an on-going program of internships and field experiences for minority students, funds are necessary to develop the energy-related capacity of research teaching and training on campus. The initial roles of government and industry seem to be reversed in this area. Industry may hesitate approaching an historically black university with a proposal for a serious research or training project if most of the expertise, experience, or technical/physical conditions for carrying it out are not already in place. While industry can and should be expected to provide for the variable cost of individual projects, the start-up cost for creating the necessary conditions for research need to come from government sources.

The proposed plan of action for next year outlines several possibilities for developing the necessary energy-related research and development capacity on campus to gradually reduce the University's dependency on government sources as this capacity grows. By providing

faculty members with opportunities to conduct energy-related research in general, and with the proposed center for testing energy management devices in particular, the plan of action will develop the research tools and experience necessary to attract independent projects later.

In each proposal for an individual project in Phase II, there is a request for funding from both government and industry sources. In addition, the budget request outlines the funds needed to keep the momentum of planning and the organizational capacity already in place. University officials view this as more than a short-term project. At the January 1984 meeting, Mr. Sewell indicated that the Department of Energy would encourage TSU to look for long-range projects which industry and the University could develop together. His statements are reported in the approved minutes (Appendix IV). Therefore, the proposed budget reflects the expectation that both the University and the Department of Energy will increase the contributions to this effort to ensure its success in the long-run.

COOPERATIVE DEVELOPMENTAL ENERGY PROJECT: PHASE II

PLAN OF ACTION

General Overview

On the basis of the findings of Phase I as reported earlier and in the attached appendices the prospect for a dramatic growth in the number of minorities that are employed in professional and managerial capacities in the energy industry is not good. The proposed plan, therefore, is an effort to take advantage of the existing opportunity of moderate growth, as well as to make a concentrated effort to increase and expand the opportunities for the future. An important consideration in developing this plan is the desire to prevent, as much as possible, that too many students will be trained for and led to believe that there are readily available careers for them, while in fact the number is quite limited and competitive. The University is deliberately avoiding the temptation of proposing a program that involves more students than the current and projected labor market in energy can absorb. The plan emphasizes the need to involve minority students in internships that present meaningful and direct technologically-related experiences which will add to their academic studies. This program will concentrate its efforts and available resources to groom those very promising individuals for those positions where they are most likely to have a successful career as professionals or administrators in the energy

industry. This program will build upon opportunities where there are existing cooperative education agreements between the university and private corporations administered through the student affairs division of the University. The proposed plan will also develop new cooperative internships and work experiences where none exist or provide for additional efforts with those companies currently cooperating with the University.

Although the target population for this plan consists of all TSU students, only a selected subgroup of students are likely to be involved and to benefit directly from all the activities that will be carried out under this plan. Job Fairs and Career Symposiums providing information about employment in the industry and meetings with representatives of or presentations by different companies will be organized to be open to all students. Participation in the internship and work experience programs, advisement about the selection of related courses, and other special activities, however, will be based upon competition between those students who show an early interest and a promising academic potential in energy-related careers.

The plan consists of three major components: 1) activities which are geared to foster adequate preparation through academic studies that may lead to internships and employment in the energy industry; 2) development of the research and training capacity of faculty members of the University; 3) special services for very promising students

to put them in touch with prospective employers, advise them about course selection, and provide employment workshops to coach them in preparation for job interviews, vita preparation, and other techniques for finding jobs. All students of the University will be invited to take advantage of employment workshops. The University considers these three independent components to be mutually supportive. The proposed approach will establish training and education for careers in the energy industry as a dynamic and on-going part of the mission of Tennessee State University.

The plan provides the tentative dates for the beginning and end of each activity for which resources are assured if Phase II of this project is partially supported by funding from DOE. The expected funds from DOE will be used as seed money to mobilize other resources on and off campus from the University and industry. We have already secured commitments for in-kind services, i.e. provision of personnel for training and workshops, particular resource materials, the use of company/agency facilities, donations to the TSU Foundation, student internships, and faculty research oppportunities. Tennessee State University has also committed in-kind support as indicated on the proposed budget. Letters attesting to the commitment of these resources and in-kind services by the energy companies and endorsing the Phase II activities described in this plan are attached separately from this report.

Plans and Proposed Activities for 1984/85 Academic Year

The following are objectives for Phase II of the cooperative program:

1. To establish the Center for Energy Education and Development at the University. The missions of this unit will be:

   a. To develop new activities and programs to improve the preparation of enrolled students for careers in energy-related occupations.

   b. To increase the awareness of students and prospective students of the different careers in energy.

   c. To develop cooperative efforts with the energy industry to train minority students for employment in the industry.

   d. To enhance and facilitate the involvement of faculty and students in energy-related research and development activities.

   e. To coordinate and implement programs to serve the community on the different economic, scientific, and technological aspects of energy production, distribution, consumption, conservation, safety, and environmental impacts.

f. To develop a network of contacts for continuous dialogue with governmental agencies and other organizations to retrieve information on opportunities for energy-related training and research. This includes, but is not limited to, membership in Oak Ridge Associate Universities, and a two-way communication with the various national laboratories and NASA on joint research and development projects.

The full proposal for the Center for Energy Education and Development which has been presented to the University is attached as Appendix V. It is expected that major support for the Center's activities during the first year of operation will come through a grant from the U.S. Department of Energy. Supplementary funds will be raised from the industry and other public agencies including the Tennessee Valley Authority (TVA). The Center will seek its own resources from the industry, TVA, and various federal and state agencies to carry out specific projects. As an expression of the University's commitment to energy education, TSU will guarantee a minimum level of support, while additional outside support is sought, as seed money to create the necessary conditions for developing external resources. Such support will be provided in terms of release time for the Center's director, office space, and administrative support.

2. To develop cooperative agreements with Nashville Electric Service, Nashville Gas Co., TVA, Shell Oil Co., Gulf Oil Co., Peabody Coal Co., and Oak Ridge National Laboratory. for student placement to allow minority students to acquire experience that may help them to obtain subsequent employment in the energy industry. This activity is part of a wider effort to identify promising students and to interest them in the pursuit of professional careers in energy. A position paper that will be used to write a specific grant proposal for this project is attached as Appendix VI.

3. To facilitate the creation of the Energy Training Consortium of Middle Tennessee. This consortium will consist of the energy-related companies in the region and will be supported through the Center for Energy Education and Development. The Consortium will allow participants to pull their resources together to provide a more flexible schedule of training activities. The consortium will enable the participating organizations to send their employees to participate in training activities on the TSU campus, when such training deals with common issues such as supervision, human relations, and other basic skills. Through such cooperation, the companies will avoid the need to pull out of the regular work schedule enough employees to make their own independent training efforts cost-effective. Through the consortium, employees of one company may also participate in the in-house training and development

activities of another company. In addition, the training director for each of the participating consortium members will make an effort to accommodate a selected group of students from TSU in training activities. Such students will be identified by the Center for Energy Education and Development for their interest in the pursuit of a career in the energy industry. Participation in such training will better prepare them for internships and subsequent employment. A summary of a preliminary consortium planning meeting, held in July 1984, is attached as Appendix VII.

4. To provide a comprehensive energy management training institute series. In cooperation with TVA, TSU will develop and offer institutes for physical-plant/maintenance managers and future energy conservation officers for institutions and organizations. Using TSU faculty and technical assistance from TVA, the institutes will train participants to conduct energy audits and to develop energy management plans. The cost of the training will be subsidized by direct grants from TVA and DOE to TSU. The participating organizations and utilities will also pay fees for the training.

5. To conduct a feasibility study for establishing an independent testing facility to assess energy management devices. The study will include an in-depth needs assessment for such independent testing, a cost-effectiveness study of the proposed approach, and prognosis of the necessary conditions for becoming a self-sufficient activity. A concept paper on the testing facility is attached as Appendix VIII.

6. To conduct a study, in cooperation with TVA, to examine the feasibility of an energy recovery project on the TSU campus for recycling paper, cans, and other reusable materials that are being discarded. Students would operate the project under supervision of the University. Proceeds from the operation would fund student activities while netting the University savings on the costs of campus up-keep. The University has also begun to involve Battelle Co., manufacturer of recycling machinery, in this study.

7. To conduct a workshop series on wood heating safety in cooperation with TVA. The workshop series will be offered to home owners, real-estate dealers, insurance agents and builders. Technical expertise will be provided by TSU faculty, TVA, the wood industry, and manufacturers of wood heaters. These workshops will also provide an opportunity to explore further cooperative agreements for student internships, faculty research, and training.

8. To conduct an annual energy careers seminar series for TSU students to familiarize them with the different careers that may be available in the energy industry and the kind of courses they need to take to prepare for them. The seminar series will be held in cooperation with various corporate representatives from the energy industry.

9. To facilitate proposals from faculty members to conduct energy-related research in cooperation with Oak-Ridge National Lab., TVA research facilities, and other private and public organizations.

SCHEDULE OF ACTIVITIES FOR 1984/85

NOTE: Commitment and support for these activities has been secured, providing that the contract between TSU and DOE for administration of Phase II is approved for continuation by August 10, 1984.

ACTIVITY	START	END	PERSONNEL	TARGET GROUP	RESOURCES
1	Aug 84	Sep 84	Director Staff	University officials	DOE TSU
			Processing of contract, setting of accounts, establishment of Center for Energy Education and Development. Cost included in overhead.		
2	Sep 84	Sep 84	Director Staff	Deans and Department Heads	DOE TSU
			Presentation of plans for the year and calendar clearing with each school and department. Cost included in overhead.		
3	Sep 84	Nov 84	Director Staff Faculty TVA	Physical Plant employees from TSU and other institutions	DOE TSU TVA Participants
			A week-long Energy Management Seminar for employees of minority institutions and minority employees. Participants will learn how to conduct energy audits for institutions (states, hospitals, office buildings, schools, and universities). Participants will develop an energy management plan and calculate costs under different contingencies. Instruction will be provided by TVA and TSU faculty members with minimal use of consultants. Participants will be awarded certificates and continuing education credits. Number of participants will be limited to 25. TVA will provide materials and most of the instruction. TVA will encourage institutional consumers in the valley area to send participants. The decision whether to hold a second seminar in the fall of 1984 will be made on the basis of the registration at the first. Format, content, and ceiling on number of participants will be evaluated before offering the seminar to a second group.		

4	Sep 84- Jan 85	Director	TSU faculty	DOE ORAU TSU

Faculty applications for summer and sabbatical appointment at DOE facilities; meeting with Oak Ridge Laboratory representatives and site visits as necessary.

5	Sep 84- Jan 85	Director	TSU students	DOE TSU ORAU

Proposal and applications for internships for graduate and undergraduate students in one of DOE's Energy Technology Centers, following a seminar with Dr. Wiesehuegel from ORAU.

6	Sep 84- Dec 84	Director Staff TVA	Wood users Insurance Agents Builders Real estate Agents	DOE TSU TVA Industry

Weekend Workshop(s) on woodheater use, safety, maintenance, and installation in cooperation with the forestry industry and the Tennessee Department of Conservation. Workshop may be repeated if enrollment exceeds 30. TSU faculty will attend workshop to develop institutional capacity to offer it in the future and to develop contacts for further educational and development opportunities. TVA and the industry will provide the materials and instructors.

7	Sep 84- Dec 84 Jan 85- Mar 85	Director Faculty	Minority high school students	DOE TSU Shell Oil

Four Weekend Workshops to a selected group of minority high school students involving hands-on lab experiments and lectures in careers in energy and the necessary background skills for admission to programs in engineering, chemistry, physics, computer science and biology. Student projects will be used for science fairs in the schools and by TSU recruiting teams. One series of workshops will be offered in the fall and one during the winter. Total number of students to be involved will be between 30 and 40. Shell Oil Company is expected to

give the Universtiy $2,000 to cover the cost of materials and extra service compensation to faculty.

8	Jan 85- Mar 85	Director TVA / NES Nashville Gas Peabody Coal Shell Oil Co. Gulf Oil Co. Phillips 66 United Cities Gas Kayo Oil Co. Student Development University College Oak Ridge Laboratory	Minority students at TSU	DOE TSU Gulf Oil

Orientation sessions and overview of possible careers with these companies; necessary skills and preparation required; internships and summer job information and interviews; employment interviews. While the various representatives will visit campus on other occasions, this conference will be held early in the semester for all interested students. Expected participation will be around 500. While each company will take care of its own expenses, Gulf Oil has given the University $500 to cover the cost of a light meal for the conference participants.

9	Jan 85- Mar 85	Director TVA / NES Nashville Gas Peabody Coal Shell Oil Co. Gulf Oil Co. Phillips 66 University College Engineering School School of Business Oak Ridge Laboratory	TSU faculty	DOE TSU

Faculty meetings with industry representatives to discuss course offerings and necessary courses to prepare for employment with those companies and other energy-related companies. Some faculty members will also be invited to visit Oak Ridge National Laboratory.

10	Sep 84- Mar 85	Director Student Development Employment Security	TSU students	DOE TSU Employment Security

Employment workshops to teach students to prepare job applications, vitas, and to perform well in job interviews.

11	Oct 84- Mar 85	Director	Energy Interns	DOE TSU

Identification of minority students with an interest in energy-related careers. Seminars on career planning and meetings with industry representatives. This group will consist of 10-20 selected students.

12	Sep 84- May 85	Director	TSU faculty and students	DOE TSU ORAU

Aspects of Energy Research and Employment Seminars utilizing ORAU's Traveling Lecture Series. Seminars will focus on areas of interest to students and faculty who wish to apply for training or research appointments with DOE.

13	Mar 85- Apr 85	Director Faculty Sponsor representatives	Energy Interns	DOE TSU

Selection of interns for summer employment with different sponsors. Selection will be done by a committee that includes the sponsors' representatives.

14	May 85- Aug 85	Director Faculty Sponsors	Energy Interns	DOE TSU Sponsors

Twelve-week internship experiences for a group of 10 students. Interns will report on their internship experience and submit a seminar paper to earn academic credit in their disciplines. Stipends to students include cost of tuition and subsidy/supplement payment which will differ according to the arrangements with each sponsor.

15	Sep 84- Aug 85	Director Energy Training Consortium	Energy Interns	DOE TSU Energy Training Consortium

Interns will be invited to participate in the training activities of the consortium and its members.

16	Sep 84- Nov 85	Director Staff Dr. Henry Taylor	Energy Interns	DOE TSU USDA

Meeting(s) with officials from rural electric companies and cooperatives to explore new internship opportunities. Dr. Henry Taylor of the USDA Rural Electrification project will pay his own travel expenses from Washington, D.C. Company officials will pay their own expenses to attend.

17	Sep 84- Aug 85	Director	TSU faculty	DOE TSU

Follow-up on research proposals and projects submitted to DOE, TVA, Shell Oil Co., Battelle Co., and develop new proposals. Proposals currently pending include:

1. Energy Management Test Center (DOE,TVA)
2. Polymer Research (DOE)
3. Energy Recovery from waste (DOE, TVA, Battelle/ Northwest Laboratory)
4. Energy Recovery from campus solid waste (DOE, TVA)
5. Underground leaks from gasoline storage tanks (Shell Oil)
6. Institutional use of solar energy: demonstration project (TVA)
7. Faculty exchange (TVA, Oak Ridge and Northwest National Labs)

APPENDIX I

Energy Education Institute

Employment of Professional and Management Occupations in Energy and Related Industries

Prepared for the

Energy Education Institute

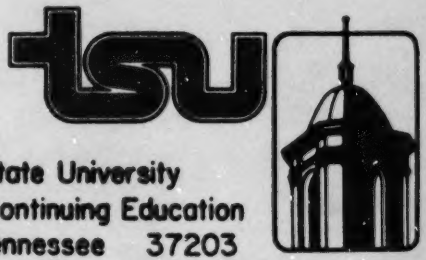
Tennessee State University

Nashville, TN 37203

By

Kirk L. Johnson

This paper is based on a research that was conducted for the Energy Education Institute of Tennessee State University with partial support from the Office of Minority Impact/U.S. Department of Energy. This paper does not necessarily reflect the official position or policies of the sponsors.



Tennessee State University
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Introduction

The analytical focus of this report is on employment of professional and management occupations in energy and related industries in the United States and Tennessee. Data were collected on the following areas:

(1) Levels of output or activity in energy and related industries.
(2) Professional and management occupations in energy and related industries.
(3) Energy research and development expenditures.

Initially, the following energy-related industries were identified using Standard Industrial Classification (SIC) Codes:

Coal mining (SIC 11-12)
Oil and gas extraction (SIC 13)
Nuclear power (SIC 1094, 2819)
Electricity generation (SIC 491)
Natural gas (SIC 1311, 4922, 4923)
Petroleum (SIC 291)
Pipelines (SIC 46)
Manufacture of selected durable products for electric companies (SIC 3443, 3511, 3612)
Heavy construction by utilities and integrated petroleum companies (SIC 1629)

These SIC Codes are described in greater detail in the Appendix to this report.

After an initial investigation, it was decided to exclude SIC 1629 (Heavy Construction, Except Highway and Street Construction). The reason for this is as follows. SIC 1629 includes general contractors engaged in the construction of at least 69 different types of heavy projects as well as projects not elsewhere classified in the SIC 16 group of industries. Consequently, SIC 1629 is not useful for identifying just energy-related construction.

The data collected were for the most current year available and, where readily available, projections were also included in the report. Where possible, data for both the United States and Tennessee were collected. Since it was found that in most cases regional data were not readily available, it was decided not to include any regional data in the report.

A major difficulty encountered during the project was obtaining current state data disaggregated to three and four digit SIC Codes. There are several reasons for this. First, disclosure problems often force the reporting agency to suppress some data. Second, survey sampling problems often result in the omission of data for some industries. Third, some surveys and censuses are not conducted annually. Finally, it would appear that at least at the national level budget reductions have resulted in delays in data processing and eliminations of some publications.

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Overview

Table 1

Table 1 reports current energy production data for the United States and Tennessee. Particularly significant is the capacity of U.S. refineries (16.9 million barrels per day) compared to U.S. crude production (8.7 million barrels per day) and the number of idle refineries.

Table 2

As Table 2 indicates, the U.S. Department of Energy is forecasting an increase in U.S. coal production during the 1980's and decreases in U.S. petroleum and natural gas production during the 1980's.

Table 3

Over 90 percent of the planned capacity additions to U.S. electric utilities during the remainder of the 1980's are either coal or nuclear. In Tennessee, all planned additions are nuclear.

Tables 4 and 5

As Table 4 indicates, approximately 68.8 percent of Federal expenditures for energy research and development in fiscal year 1983 was for nuclear programs. Table 5, on the other hand, indicates that the majority of private industry energy research and development expenditures was for nonconventional energy.

Tables 6 and 7

Tables 6 and 7 report the most current data available on selected manufacturing statistics in energy-related industries in the U.S. and Tennessee. The reporting lag in the Tennessee data in Table 7 is particularly a problem because of possible changes in energy-related industries during the 1979-1980 time frame.

Tables 8, 9, 10, and 11

These tables report statistics regarding number of employees, number of establishments, and payrolls for energy-related industries in the United States and Tennessee. As Table 8 and Figure 1 indicate, the oil and gas extraction industry (SIC 13) is a large employer among energy-related industries in the United States although the combined electric and gas utilities industry (SIC 491, 492, 493) also employ a large number of workers.

In analyzing the data on Tennessee reported in Tables 9 and 11 and Figures 2 and 3, it should be emphasized that the data on electric and gas utilities do not include government employees. Since TVA and Tennessee municipalities account for a great deal of the employment in this sector, caution should be exercised in analyzing the Tennessee data.

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Table 12

Table 12 is an industry-occupation matrix for selected energy-related industries. The data for Figure 4 were derived by multiplying the percentages in Table 12 with employment estimates from the source document. As Figure 4 indicates, the coal mining and oil and gas extraction industries are forecasted to have an increasing demand for certain professional and management personnel.

Tables 13 and 14

These tables report current and projected employment in selected occupations for the U.S. and Tennessee. The occupations selected are those which are found in energy and related industries.

Tables 15 and 16

As noted above, Tables 8-11 do not include government employees. Table 15 reports the most current data available on the number of government employees in Tennessee who work for municipal distributors of electricity or gas. Table 16 reports the number of employees and average salary of selected Tennessee Valley Authority occupations.

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Table 1. United States and Tennessee--Selected Energy Statistics: 1982

COAL

	Number of Mines*	Number of Mining Operations**	Number of Miners***	Production (Thousand Tons)	Average Mine Price ($ Per Ton)
United States	4,098	4,867	217,117	832,524	27.25
Tennessee	105	130	4,047	7,287	29.49

*Excludes mines producing less than 10,000 short tons of coal during the year.
**Includes preparation plants.
***Includes all employees engaged in production, preparation, processing, development, maintenance, repair, shop or yard work at mining operations. Excludes office workers. Includes mining operations management and all technical and engineering personnel.

PETROLEUM

	Crude Oil Production (Thousand Barrels)		Number of Operable Refineries			Capacity Barrels Per Day
	Total	Per Day	Total	Operating	Idle	
United States	3,156,715	8,649	258	233	25	16,859,337
Tennessee	1,132	3	1	1	0	49,500

NATURAL GAS

	Marketed Production (Million Cubic Feet)	Number of Gas Producing Wells	Imputed Wellhead Value of Marketed Production (Thousand Dollars)
United States	18,519,675	210,753	45,496,765
Tennessee	2,976	340	8,928

ELECTRIC UTILITIES

	Number of Plants	Installed Capacity (Megawatts)	Net Generation (Megawatthours)
United States	3,036	650,105	2,241,211,367
Tennessee	38	18,270	59,504,897

Sources: U. S. Department of Energy, Coal Production, 1982 (September 1983); Petroleum Supply Annual (June 1983); Natural Gas Annual, 1982 (October 1983); Electric Power Annual, 1982 (August 1983).

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Table 2. United States--Forecasts of Energy Production: 1990

	1982	1990	Per Change
Coal--Million Tons	833	1,080	29.7
Petroleum*--Million Barrels Per Day	10.3	9.5	-7.8
Natural Gas--Trillion Cubic Feet	17.5**	15.9	- 9.1

*Includes crude oil, natural gas plant production, other hydrocarbons, and alcohol.

**The discrepancy in this statistic and the statistic reported in Table 1 is unexplained.

Note: Forecasts based on middle world oil price case of $37 per barrel (1982 dollars).

Source: U. S. Department of Energy, 1982 Annual Energy Outlook, (May 1983).

Table 3. United States and Tennessee--Electric Utilities Planned Capacity Additions by Energy Source: 1983-1992

(Megawatts)

	United States	Tennessee
Total	143,854	2,540
Coal	65,681	0
Petroleum	1,287	0
Gas	347	0
Water	9,582	0
Nuclear	66,060	2,540
Other	898	0

Source: U. S. Department of Energy, Inventory of Power Plants, 1982 Annual, (June 1983).

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Table 4. Federal Support for Energy Research and Development Programs: Estimated Fiscal Year 1983

Agency and Program	Million Dollars
Total	2,034
Energy Research and Technology Administration*	1,779
Solar	73
Geothermal	10
Hydropower	---
Nuclear fission	717
Magnetic fusion	359
Electric energy and energy storage systems	---
Biological and environmental research	121
Supporting research	273
Fossil energy	104
Energy conversation	19
Uranium enrichment	104
Other	---
Nuclear Regulatory Commission	220
Environmental Protection Agency	35

*Under the 1983 Reagan Administration budget, the U. S. Department of Energy was to be abolished and the research and development programs were to be administered by the Energy Research and Technology Administration of the U. S. Department of Commerce.

Source: National Science Foundation, Federal R & D Funding for Energy: Fiscal Years 1971-84, (February 1983).

Table 5. Expenditures for Energy Research and Development by Industry: 1979

	Million Dollars
Total	3,688
Petroleum	667
Coal, Conventional	72
Nuclear	996
Nonconventional Energy	1,953
Synthetic Fuels	235
Renewable Energy and Other	1,667

Source: U. S. Department of Energy, Energy Company Development Patterns in the Postembargo Era (October 1982).

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Table 6. United States--Value Added by Manufacture, Value of Shipments, and New Capital Expenditures in Selected Industries: 1981
(Million Dollars)

SIC Code	Industry	Value Added by Manu-facture	Value of Shipments	New Capital Expen-ditures
	Total, All Manufacturing Industries	837,506.5	2,017,542.5	78,632.3
28	Chemicals and allied products	80,032.3	180,459.2	9,470.6
281	Industrial inorganic chemicals	9,273.6	17,944.7	1,111.6
2819	Industrial inorganic chemicals,nec	6,754.8	12,790.2	657.6
29	Petroleum and coal products	26,740.3	224,131.4	5,157.9
2911	Petroleum refining	24,149.0	215,056.1	4,942.7
34	Fabricated metal products	61,558.2	123,661.6	4,573.2
344	Fabricated structural metal products	16,222.5	36,610.4	906.5
3443	Fabricated plate work(boiler shops)	4,994.4	9,923.4	258.9
35	Machinery, except electrical	111,393.7	201,539.1	8,821.9
351	Engines and turbines	7,381.6	15,280.8	715.5
3511	Turbines and turbine generator sets	2,123.3	3,735.2	78.5
36	Electric and electronic equipment	79,720.4	140,194.4	6,645.3
361	Electric distributing equipment	4,827.2	8,343.7	219.0
3612	Transformers	1,578.9	3,208.8	80.5

Source: U.S. Department of Commerce, Bureau of the Census, 1981 Annual Survey of Manufactures: Statistics for Industry Groups and Industries, (April 1983).

Table 7. Tennessee--Value Added by Manufacture, Value of Shipments, and New Capital Expenditures in Selected Industries: 1978
(Million Dollars)

SIC Code	Industry	Value Added by Manu-facture	Value of Shipments	New Capital Expen-ditures
	Total, All Manufacturing Industries	14,405.8	31,750.2	1,156.2
28	Chemicals and allied products	2,433.7	4,981.7	190.3
281	Industrial inorganic chemicals	1,036.0	1,682.6	71.1
2819	Industrial inorganic chemicals,nec	924.7	1,481.6	57.8
29	Petroleum and coal products	116.6	405.4	7.6
291	Petroleum refining	---	---	---
34	Fabricated metal products	921.7	1,894.6	53.1
344	Fabricated structural metal products	371.2	812.1	26.9
3443	Fabricated plate work(boiler shops)	180.1	381.1	9.6
35	Machinery, except electrical	1,195.4	2,183.1	61.2
351	Engines and turbines	---	---	---
3511	Turbines and turbine generator sets	---	---	---
36	Electric and electronic equipment	1,143.9	2,453.1	78.2
361	Electric distributing equipment	---	---	---
3612	Transformers	---	---	---

Source: U.S. Department of Commerce, Bureau of the Census, 1978-1979 Annual Survey of Manufactures, (January 1983).

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Table 8. United States--Number of Employees, Number of Establishments, and Average Number of Employees Per Establishment in Selected Industries: 1981

SIC Code	Industry	Number of Employees	Number of Establish-ments	Average Number of Employees Per Esta-blishment
Total, All Industries		74,850,402	4,586,510	16.32
....	Mining	1,107,726	33,196	33.37
10	Metal mining	93,772	1,014	92.48
109	Miscellaneous metal ores	15,414	222	69.43
1094	Uranium-radium-vanadium ores	13,907	162	85.85
11	Anthracite mining	3,639	168	21.66
1111	Anthracite	3,380	135	25.04
1112	Anthracite mining services	209	21	9.95
12	Bituminous coal and lignite mining	240,342	4,058	59.23
1211	Bituminous coal and lignite	232,480	3,663	63.47
1213	Bituminous and lignite mining serv.	7,668	349	21.97
13	Oil and gas extraction	550,426	21,501	25.60
131	Crude petroleum and natural gas	153,473	7,854	19.54
132	Natural gas liquids	13,265	680	19.51
138	Oil and gas field services	382,669	12,667	30.21
1381	Drilling oil and gas wells	153,592	3,093	49.66
1382	Oil and gas field exploration serv.	45,760	2,660	17.20
1389	Oil and gas field services, nec	173,621	5,694	30.49
....	Manufacturing	20,428,330	321,290	63.58
28	Chemicals and allied products	910,325	11,243	80.97
281	Industrial inorganic chemicals	113,510	1,260	90.09
2819	Industrial inorganic chemicals,nec	84,566	585	144.56
29	Petroleum and coal products	154,178	2,186	70.53
291	Petroleum refining	110,345	444	248.52
34	Fabricated metal products	1,584,226	31,557	50.20
344	Fabricated structural metal products	451,482	11,025	40.95
3443	Fabricated plate work(boiler shops)	121,450	1,709	71.06
35	Machinery, except electrical	2,420,858	47,191	51.30
351	Engines and turbines	122,254	283	431.99
3511	Turbines and turbine generator sets	35,274	83	424.99
36	Electric and electronic equipment	1,960,337	14,142	138.62
361	Electric distributing equipment	119,432	859	139.04
3612	Transformers	45,593	275	165.79
....	Transportation & other public utilities	4,613,030	171,614	26.88
46	Pipe lines, except natural gas	17,676	530	33.35
49	Electric, gas, and sanitary services	767,224	16,067	47.75
491	Electric services	381,922	4,553	83.88
492	Gas production and distribution	134,311	2,974	45.16
493	Combination utility services	168,890	964	175.20
4931	Electric & other services combined	122,801	697	176.19
4932	Gas & other services combined	41,987	142	295.68
4939	Combination utility services, nec	4,032	106	38.04

NOTE: Excludes government employees, railroad employees, self-employed persons, etc.

Source: U.S. Department of Commerce, Bureau of the Census, County Business Patterns, 1981: United States (July 1983).

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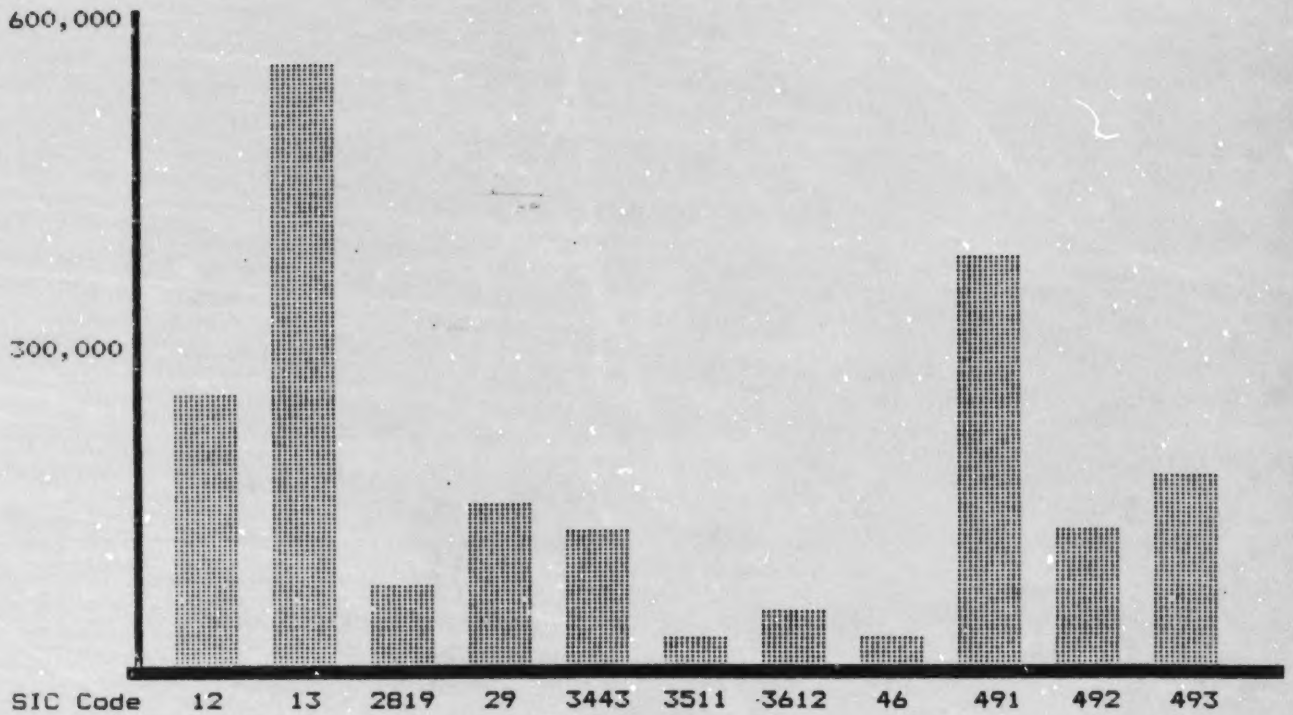
Figure 1. United States--Number of Employees in Selected Industries: 1981



SIC Codes

12 = Bituminous coal and lignite mining
13 = Oil and gas extraction
2819 = Industrial inorganic chemicals, nec
29 = Petroleum and coal products
3443 = Fabricated plate work (boiler shops)
3511 = Turbine and turbine generator sets
3612 = Transformers
46 = Pipelines
491 = Electric services
492 = Gas Production and Distribution
493 = Combination utility services

Source: U.S. Department of Commerce, Bureau of the Census, County Business Patterns, 1981: United States, (July 1983).

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Table 9. Tennessee--Number of Employees, Number of Establishments, and Average Number of Employees Per Establishment in Selected Industries: 1981

SIC Code	Industry	Number of Employees	Number of Establishments	Average Number of Employees Per Establishment
Total, All Industries		1,417,231	83,048	17.07
....	Mining	9,825	420	23.39
10	Metal mining	1,378	10	137.80
109	Miscellaneous metal ores	---	---	---
1094	Uranium-radium-vanadium ores	---	---	---
11	Anthracite mining	---	---	---
1111	Anthracite	---	---	---
1112	Anthracite mining services	---	---	---
12	Bituminous coal and lignite mining	4,288	177	24.23
1211	Bituminous coal and lignite	4,095	165	24.82
1213	Bituminous and lignite mining serv.	193	12	16.08
13	Oil and gas extraction	748	76	9.84
131	Crude petroleum and natural gas	(E)	26	---
132	Natural gas liquids	---	---	---
138	Oil and gas field services	394	48	8.21
1381	Drilling oil and gas wells	218	22	9.91
1382	Oil and gas field exploration serv.	---	---	---
1389	Oil and gas field services, nec	127	13	9.77
....	Manufacturing	493,583	5,753	85.80
28	Chemicals and allied products	52,385	232	225.80
281	Industrial inorganic chemicals	17,784	43	413.58
2819	Industrial inorganic chemicals,nec	16,626	19	875.05
29	Petroleum and coal products	1,235	35	35.29
291	Petroleum refining	(E)	2	---
34	Fabricated metal products	35,095	486	72.21
344	Fabricated structural metal products	14,295	219	65.27
3443	Fabricated plate work(boiler shops)	5,813	32	181.66
35	Machinery, except electrical	32,972	584	56.46
351	Engines and turbines	(E)	2	---
3511	Turbines and turbine generator sets	---	---	---
36	Electric and electronic equipment	41,031	196	209.34
361	Electric distributing equipment	1,776	12	148.00
3612	Transformers	(E)	4	---
....	Transportation & other public utilities	72,725	2,912	24.97
46	Pipe lines, except natural gas	44	15	2.93
49	Electric, gas, and sanitary services	4,544	192	23.67
491	Electric services	2,032	54	37.63
492	Gas production and distribution	1,200	27	44.44
493	Combination utility services	(C)	4	---
4931	Electric & other services combined	---	---	---
4932	Gas & other services combined	---	---	---
4939	Combination utility services, nec	(C)	2	---

NOTE: Excludes government employees, railroad employees, self-employed persons.etc. D denotes figures withheld to avoid disclosure of operations of individual establishments, the other alphabetics indicate employment-size class. A:0-19; B:20-99; C:100-249; E:250-499; F:500-999.

Source: U.S. Department of Commerce, Bureau of the Census, County Business Patterns, 1981: Tennessee, (January 1983).

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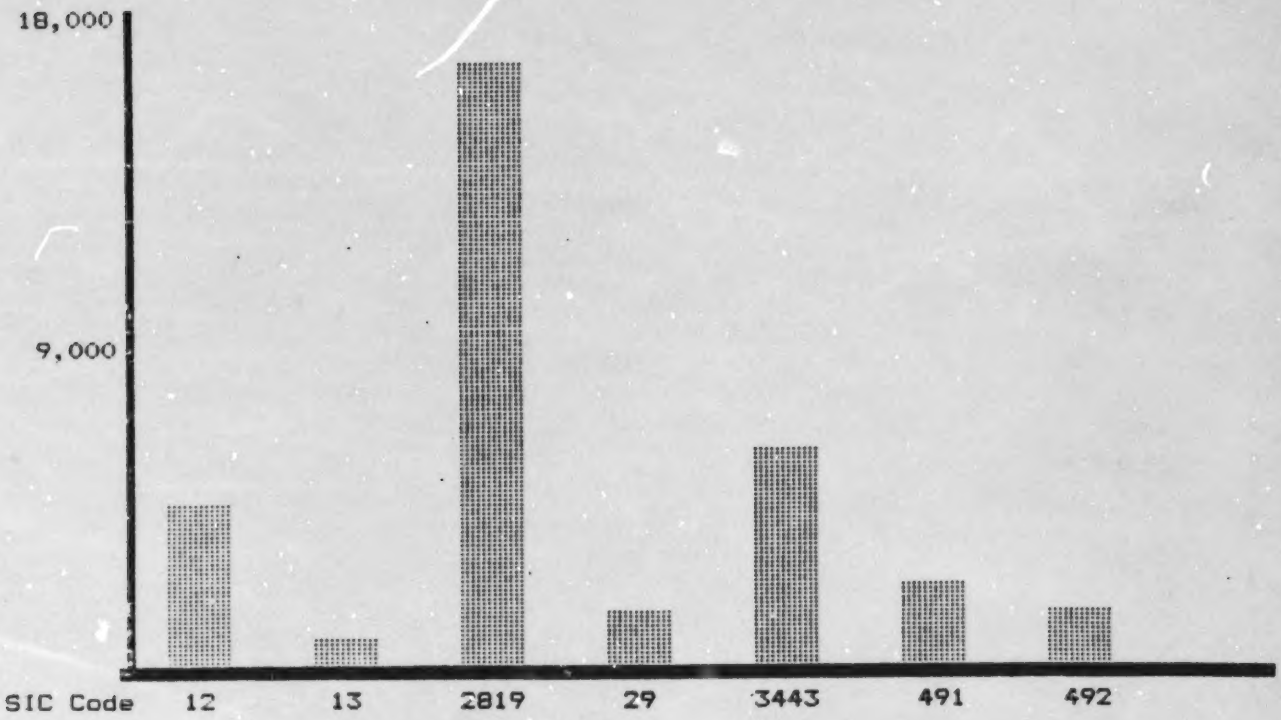
Figure 2. Tennessee--Number of Employees in Selected Industries: 1981



SIC Codes

12 = Bituminous coal and lignite mining
13 = Oil and gas extraction
2819 = Industrial inorganic chemicals, nec
29 = Petroleum and coal products
3443 = Fabricated plate work (boiler shops)
491 = Electric services
492 = Gas Production and Distribution

Source: U.S. Department of Commerce, Bureau of the Census, County Business Patterns, 1981: Tennessee, (January 1983).

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Table 10. United States--Number of Employees, Payroll, and Average Wage Per Employee in Selected Industries: 1981

SIC Code	Industry	Number of Employees	Payroll (Thousand Dollars)	Average Wage Per Employee
Total, All Industries		74,850,402	1,149,719,124	15,360
....	Mining	1,107,726	27,554,948	24,875
10	Metal mining	93,772	2,297,852	24,505
109	Miscellaneous metal ores	15,414	352,237	22,852
1094	Uranium-radium-vanadium ores	13,907	326,691	23,491
11	Anthracite mining	3,639	64,171	17,634
1111	Anthracite	3,380	60,198	17,810
1112	Anthracite mining services	209	3,228	15,445
12	Bituminous coal and lignite mining	240,342	5,845,505	24,322
1211	Bituminous coal and lignite	232,480	5,665,156	24,368
1213	Bituminous and lignite mining serv.	7,668	178,382	23,263
13	Oil and gas extraction	550,426	13,640,703	24,782
131	Crude petroleum and natural gas	153,473	4,260,226	27,759
132	Natural gas liquids	13,265	354,190	26,701
138	Oil and gas field services	382,669	9,009,871	23,545
1381	Drilling oil and gas wells	153,592	3,823,412	24,893
1382	Oil and gas field exploration serv.	45,760	1,037,061	22,663
1389	Oil and gas field services, nec	173,621	3,935,887	22,669
....	Manufacturing	20,428,330	388,060,276	18,996
28	Chemicals and allied products	910,325	20,308,091	22,309
281	Industrial inorganic chemicals	113,510	2,690,868	23,706
2819	Industrial inorganic chemicals,nec	84,566	2,019,368	23,879
29	Petroleum and coal products	154,178	4,148,258	26,906
291	Petroleum refining	110,345	3,204,399	29,040
34	Fabricated metal products	1,584,226	29,559,072	18,658
344	Fabricated structural metal products	451,482	8,202,709	18,168
3443	Fabricated plate work(boiler shops)	121,450	2,474,653	20,376
35	Machinery, except electrical	2,420,858	50,099,284	20,695
351	Engines and turbines	122,254	3,066,925	25,087
3511	Turbines and turbine generator sets	35,274	869,816	24,659
36	Electric and electronic equipment	1,960,337	36,393,682	18,565
361	Electric distributing equipment	119,432	2,074,368	17,369
3612	Transformers	45,593	773,614	16,968
....	Transportation & other public utilities	4,613,030	97,405,652	21,115
46	Pipe lines, except natural gas	17,676	512,778	29,010
49	Electric, gas, and sanitary services	767,224	17,970,541	23,423
491	Electric services	381,922	9,163,342	23,993
492	Gas production and distribution	134,311	2,990,536	22,266
493	Combination utility services	168,890	4,388,120	25,982
4931	Electric & other services combined	122,801	3,172,687	25,836
4932	Gas & other services combined	41,987	1,133,659	27,000
4939	Combination utility services, nec	4,032	80,908	20,066

NOTE: Excludes government employees, railroad employees, self-employed persons, etc.

Source: U.S. Department of Commerce, Bureau of the Census, County Business Patterns, 1981: United States (July 1983).

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Table 11. Tennessee--Number of Employees, Payroll, and Average Wage Per Employee Per Establishment in Selected Industries: 1981

SIC Code	Industry	Number of Employees	Payroll (Thousand Dollars)	Average Wage Per Employee
Total, All Industries		1,417,231	18,867,605	13,313
....	Mining	9,825	191,738	19.515
10	Metal mining	1,378	28,550	20,718
109	Miscellaneous metal ores	---	---	---
1094	Uranium-radium-vanadium ores	---	---	---
11	Anthracite mining	---	---	---
1111	Anthracite	---	---	---
1112	Anthracite mining services	---	---	---
12	Bituminous coal and lignite mining	4,288	92,643	21,605
1211	Bituminous coal and lignite	4,095	87,718	21,421
1213	Bituminous and lignite mining serv.	193	4,926	25,523
13	Oil and gas extraction	748	11,596	15,503
131	Crude petroleum and natural gas	(E)	(D)	---
132	Natural gas liquids	---	---	---
138	Oil and gas field services	394	6,658	16,898
1381	Drilling oil and gas wells	218	3,277	15,072
1382	Oil and gas field exploration serv.	---	---	---
1389	Oil and gas field services, nec	127	2,455	19,331
....	Manufacturing	493,583	7,415,990	15,025
28	Chemicals and allied products	52,385	1,129,173	21,555
281	Industrial inorganic chemicals	17,784	400,619	22,527
2819	Industrial inorganic chemicals,nec	16,626	371,348	22,335
29	Petroleum and coal products	1,235	23,257	18,832
291	Petroleum refining	(E)	(D)	---
34	Fabricated metal products	35,095	560,390	15,968
344	Fabricated structural metal products	14,295	248,979	17,417
3443	Fabricated plate work(boiler shops)	5,813	119,613	20,577
35	Machinery, except electrical	32,972	539,559	16,364
351	Engines and turbines	(E)	(D)	---
3511	Turbines and turbine generator sets	---	---	---
36	Electric and electronic equipment	41,031	595,184	14,506
361	Electric distributing equipment	1,776	25,781	14,516
3612	Transformers	(E)	(D)	---
....	Transportation & other public utilities	72,725	1,418,024	19,498
46	Pipe lines, except natural gas	44	1,183	26,886
49	Electric, gas, and sanitary services	4,544	79,641	17,527
491	Electric services	2,032	38,044	18,722
492	Gas production and distribution	1,200	22,976	19,147
493	Combination utility services	(C)	(D)	---
4931	Electric & other services combined	---	---	---
4932	Gas & other services combined	---	---	---
4939	Combination utility services, nec	(C)	(D)	---

NOTE: Excludes government employees, railroad employees, self-employed persons, etc. D denotes figures withheld to avoid disclosure of operations of individual establishments, the other alphabetics indicate employment-size class. A:0-19; B:20-99; C:100-249; E:250-499; F:500-999.

Source: U.S. Department of Commerce, Bureau of the Census, County Business Patterns, 1981: Tennessee (January 1983).

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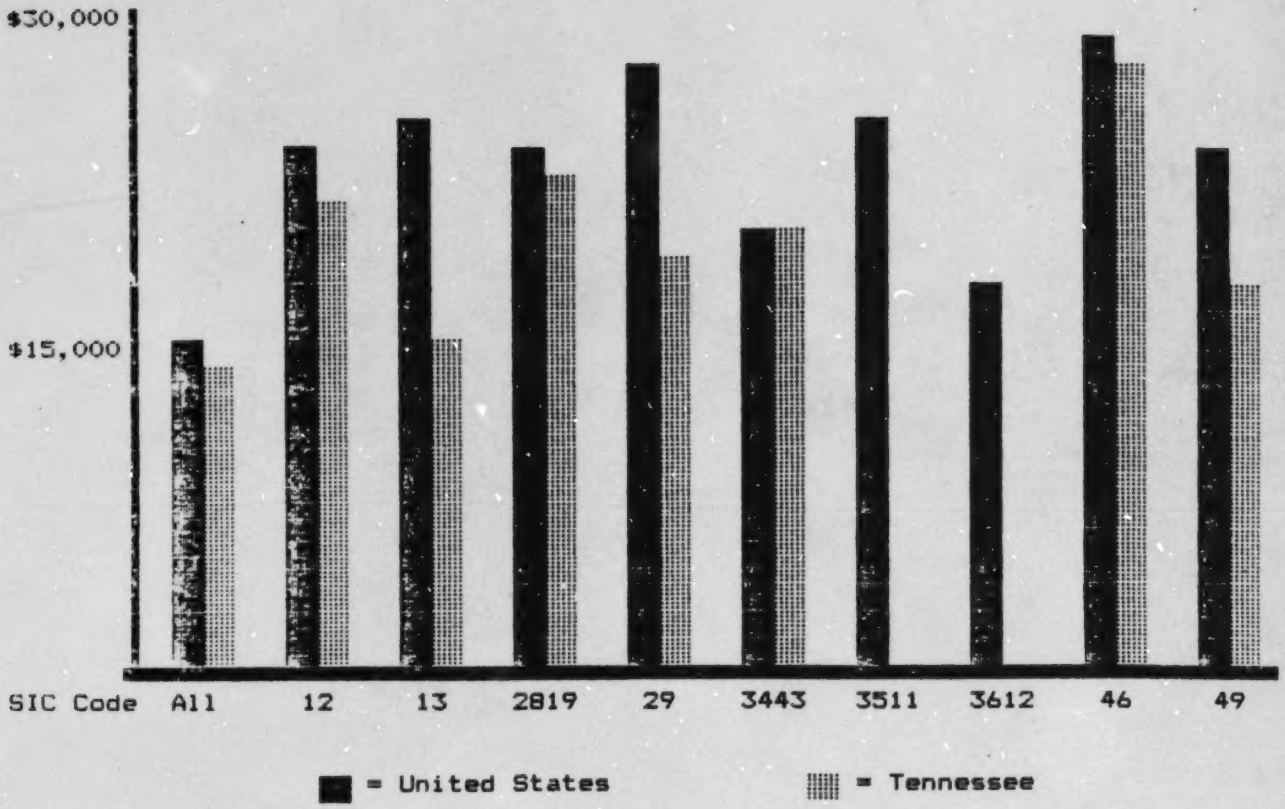
Figure 3. United States and Tennessee--Average Wage for Selected Industries 1981



SIC Codes

All = All industries
12 = Bituminous coal and lignite mining
13 = Oil and gas extraction
2819 = Industrial inorganic chemicals, nec
29 = Petroleum and coal products
3443 = Fabricated plate work (boiler shops)
3511 = Turbine and turbine generator sets (Tennessee data not available)
3612 = Transformers (Tennessee data not available)
46 = Pipelines
49 = Electric, gas, and sanitary services

Source: U.S. Department of Commerce, Bureau of the Census, County Business Patterns, 1981: United States, (July 1983); and County Business Patterns, 1981: Tennessee, (January 1983).

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Table 12. United States--Selected Occupations as Percent of Total Employment of Selected Industries: (1978 and Projected 1990)

Occupation	Metal Mining 1978	Metal Mining 1990	Coal Mining 1978	Coal Mining 1990
Professional and Technical	9.43	9.70	2.28	2.66
Engineers, technical	2.61	3.15	0.92	1.18
Aeronautical Engineers	0.00	0.00	0.00	0.00
Chemical Engineers	0.07	0.06	0.02	0.03
Civil Engineers	0.11	0.13	0.07	0.10
Electrical Engineers	0.11	0.11	0.06	0.04
Industrial Engineers	0.24	0.22	0.09	0.12
Mechanical Engineers	0.15	0.13	0.06	0.05
Metallurgical Engineers	0.18	0.16	0.00	0.00
Mining Engineers	1.67	2.25	0.60	0.83
Petroleum Engineers	0.02	0.02	0.00	0.00
Sales Engineers	0.01	0.01	0.00	0.00
Other Engineers	0.06	0.07	0.02	0.02
Life and Physical Scientists	2.40	2.44	0.20	0.22
Agricultural Scientists	0.00	0.00	0.00	0.00
Atmosheric and Space Scientists	0.00	0.00	0.00	0.00
Biological Scientists	0.00	0.00	0.00	0.00
Chemists	1.13	0.95	0.16	0.16
Geologists	1.27	1.49	0.04	0.06
Marine Scientists	0.00	0.00	0.00	0.00
Physicists and Astronomers	0.00	0.00	0.00	0.00
Other Life and Physical Scientists	0.00	0.00	0.00	0.00
Mathematical Specialists	0.01	0.01	0.00	0.00
Actuaries	0.00	0.00	0.00	0.00
Mathematicians	0.00	0.00	0.00	0.00
Statisticians	0.01	0.01	0.00	0.00
Computer Specialists	0.30	0.26	0.04	0.05
Computer Programmers	0.17	0.14	0.03	0.03
Computer Systems Analysts	0.13	0.11	0.02	0.02
Other Computer Specialists	0.01	0.01	0.00	0.00
Social Scientists	0.03	0.03	0.02	0.02
Economists	0.03	0.03	0.02	0.02
Other Professional and Technical	1.96	1.43	0.54	0.52
Accountants	1.21	0.96	0.36	0.32
Architects	0.00	0.00	0.00	0.00
Foresters and Conservationists	0.00	0.00	0.02	0.02
Home Management Advisors	0.00	0.00	0.00	0.00
Lawyers	0.22	0.18	0.08	0.10
Librarians	0.00	0.00	0.00	0.00
Operations and Systems Research	0.10	0.08	0.02	0.01
Personnel, Labor Relations Workers	0.31	0.15	0.06	0.03
Other Research Workers	0.11	0.05	0.01	0.03
Managers, Officials, Propr.	3.57	3.11	2.88	2.54
Buyers, Sales, and Loan Managers	0.53	0.54	0.25	0.23
Bank, Financial Managers	0.11	0.09	0.03	0.02
Credit Managers	0.00	0.00	0.00	0.00
Purchasing Agents, Buyers, Other	0.35	0.36	0.18	0.17
Sales Managers, Excl. Retail Trade	0.07	0.08	0.04	0.05
Other Managers, Officials, Proprietors	3.04	2.57	2.63	2.31
Managers, Superintendents, Building	0.00	0.00	0.01	0.02
Office Managers, Other	0.25	0.31	0.13	0.11
Other Managers, Administrators	2.78	2.25	2.49	2.17

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Table 12. United States--Selected Occupations as Percent of Total Employment of Selected Industries: (1978 and Projected 1990)

Occupation	Oil & Gas Extraction 1978	Oil & Gas Extraction 1990	Petroleum Refining 1978	Petroleum Refining 1990
Professional and Technical	19.38	21.22	23.78	23.15
Engineers, technical	4.85	5.81	5.49	5.81
Aeronautical Engineers	0.00	0.00	0.00	0.00
Chemical Engineers	0.28	0.22	2.95	3.15
Civil Engineers	0.23	0.26	0.32	0.30
Electrical Engineers	0.25	0.20	0.27	0.22
Industrial Engineers	0.23	0.20	0.30	0.31
Mechanical Engineers	0.39	0.44	0.69	0.72
Metallurgical Engineers	0.03	0.04	0.05	0.08
Mining Engineers	0.17	0.20	0.00	0.00
Petroleum Engineers	3.02	4.01	0.61	0.77
Sales Engineers	0.12	0.13	0.06	0.04
Other Engineers	0.13	0.12	0.24	0.23
Life and Physical Scientists	4.42	5.69	2.20	2.33
Agricultural Scientists	0.00	0.00	0.01	0.00
Atmosheric and Space Scientists	0.00	0.00	0.00	0.00
Biological Scientists	0.01	0.02	0.02	0.01
Chemists	0.45	0.49	1.64	1.67
Geologists	3.89	5.09	0.44	0.58
Marine Scientists	0.02	0.04	0.00	0.00
Physicists and Astronomers	0.05	0.06	0.06	0.05
Other Life and Physical Scientists	0.00	0.00	0.03	0.02
Mathematical Specialists	0.07	0.05	0.13	0.10
Actuaries	0.00	0.00	0.01	0.01
Mathematicians	0.03	0.03	0.06	0.05
Statisticians	0.03	0.02	0.06	0.04
Computer Specialists	1.10	1.18	1.69	1.80
Computer Programmers	0.63	0.66	0.89	0.98
Computer Systems Analysts	0.41	0.49	0.71	0.77
Other Computer Specialists	0.06	0.03	0.09	0.05
Social Scientists	0.23	0.21	1.12	0.77
Economists	0.22	0.21	1.09	0.75
Other Professional and Technical	4.44	3.34	5.98	4.72
Accountants	3.05	2.54	3.33	2.95
Architects	0.00	0.00	0.00	0.00
Foresters and Conservationists	0.02	0.05	0.00	0.00
Home Management Advisors	0.00	0.00	0.00	0.00
Lawyers	0.70	0.35	0.92	0.65
Librarians	0.03	0.01	0.05	0.01
Operations and Systems Research	0.15	0.10	0.57	0.46
Personnel, Labor Relations Workers	0.40	0.25	0.82	0.56
Other Research Workers	0.10	0.04	0.30	0.09
Managers, Officials, Propr.	10.55	9.55	7.27	7.15
Buyers, Sales, and Loan Managers	1.69	1.67	1.28	1.08
Bank, Financial Managers	0.12	0.06	0.19	0.12
Credit Managers	0.04	0.04	0.10	0.06
Purchasing Agents, Buyers, Other	1.18	1.17	0.51	0.38
Sales Managers, Excl. Retail Trade	0.36	0.40	0.47	0.52
Other Managers, Officials, Proprietors	8.87	7.88	6.00	6.07
Managers, Superintendents, Building	0.02	0.05	0.02	0.02
Office Managers, Other	0.58	0.72	0.26	0.25
Other Managers, Administrators	8.06	6.90	5.65	5.74

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Table 12. United States--Selected Occupations as Percent of Total Employment of Selected Industries: (1978 and Projected 1990)

Occupation	Industrial Chemicals 1978	Industrial Chemicals 1990	Fab. Structural Metal Products 1978	Fab. Structural Metal Products 1990
Professional and Technical	23.85	24.65	7.09	5.74
Engineers, technical	6.09	6.57	1.90	1.27
Aeronautical Engineers	0.00	0.00	0.00	0.00
Chemical Engineers	3.88	4.20	0.02	0.01
Civil Engineers	0.16	0.18	0.20	0.10
Electrical Engineers	0.51	0.55	0.21	0.23
Industrial Engineers	0.51	0.52	0.41	0.24
Mechanical Engineers	0.71	0.76	0.54	0.35
Metallurgical Engineers	0.05	0.05	0.11	0.08
Mining Engineers	0.01	0.01	0.00	0.00
Petroleum Engineers	0.01	0.01	0.00	0.00
Sales Engineers	0.08	0.09	0.14	0.04
Other Engineers	0.17	0.19	0.29	0.22
Life and Physical Scientists	4.23	4.22	0.12	0.11
Agricultural Scientists	0.03	0.04	0.00	0.00
Atmosheric and Space Scientists	0.01	0.01	0.01	0.02
Biological Scientists	0.21	0.15	0.00	0.00
Chemists	3.69	3.78	0.07	0.03
Geologists	0.00	0.00	0.00	0.00
Marine Scientists	0.00	0.00	0.00	0.00
Physicists and Astronomers	0.26	0.22	0.03	0.04
Other Life and Physical Scientists	0.03	0.02	0.01	0.02
Mathematical Specialists	0.08	0.09	0.01	0.01
Actuaries	0.01	0.01	0.00	0.00
Mathematicians	0.03	0.02	0.00	0.00
Statisticians	0.05	0.06	0.01	0.01
Computer Specialists	0.78	0.64	0.27	0.23
Computer Programmers	0.46	0.39	0.16	0.14
Computer Systems Analysts	0.26	0.20	0.08	0.08
Other Computer Specialists	0.07	0.05	0.02	0.01
Social Scientists	0.46	0.39	0.09	0.09
Economists	0.46	0.39	0.09	0.09
Other Professional and Technical	3.40	2.46	1.66	1.38
Accountants	1.55	1.13	1.14	1.06
Architects	0.02	0.02	0.01	0.00
Foresters and Conservationists	0.00	0.00	0.00	0.00
Home Management Advisors	0.00	0.00	0.00	0.00
Lawyers	0.27	0.14	0.04	0.02
Librarians	0.07	0.06	0.00	0.00
Operations and Systems Research	0.41	0.39	0.16	0.12
Personnel, Labor Relations Workers	0.62	0.36	0.29	0.17
Other Research Workers	0.46	0.38	0.02	0.00
Managers, Officials, Propr.	7.96	8.88	9.02	8.88
Buyers, Sales, and Loan Managers	1.61	1.99	1.39	1.12
Bank, Financial Managers	0.20	0.18	0.12	0.06
Credit Managers	0.04	0.04	0.05	0.06
Purchasing Agents, Buyers, Other	0.58	0.71	0.62	0.41
Sales Managers, Excl. Retail Trade	0.78	1.06	0.60	0.58
Other Managers, Officials, Proprietors	6.35	6.89	7.63	7.76
Managers, Superintendents, Building	0.02	0.03	0.00	0.00
Office Managers, Other	0.34	0.43	0.40	0.37
Other Managers, Administrators	5.98	6.41	7.22	7.37

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Table 12. United States--Selected Occupations as Percent of Total Employment of Selected Industries: (1978 and Projected 1990)

Occupation	Engines & Turbines 1978	Engines & Turbines 1990	Other Electric Machinery 1978	Other Electric Machinery 1990
Professional and Technical	13.15	11.73	16.00	14.02
Engineers, technical	5.22	4.57	6.34	5.43
Aeronautical Engineers	0.09	0.05	0.02	0.00
Chemical Engineers	0.03	0.00	0.08	0.02
Civil Engineers	0.03	0.00	0.02	0.00
Electrical Engineers	0.58	0.50	3.78	2.93
Industrial Engineers	1.07	1.00	1.17	1.43
Mechanical Engineers	2.13	1.87	0.60	0.43
Metallurgical Engineers	0.20	0.24	0.05	0.06
Mining Engineers	0.00	0.00	0.00	0.00
Petroleum Engineers	0.00	0.00	0.00	0.00
Sales Engineers	0.06	0.00	0.19	0.15
Other Engineers	1.04	0.90	0.43	0.41
Life and Physical Scientists	0.24	0.26	0.26	0.21
Agricultural Scientists	0.00	0.00	0.00	0.00
Atmosheric and Space Scientists	0.00	0.00	0.01	0.01
Biological Scientists	0.00	0.00	0.01	0.02
Chemists	0.20	0.21	0.15	0.10
Geologists	0.00	0.00	0.00	0.00
Marine Scientists	0.00	0.00	0.00	0.00
Physicists and Astronomers	0.03	0.05	0.09	0.07
Other Life and Physical Scientists	0.00	0.00	0.00	0.00
Mathematical Specialists	0.03	0.05	0.04	0.04
Actuaries	0.00	0.00	0.00	0.00
Mathematicians	0.00	0.00	0.01	0.01
Statisticians	0.03	0.05	0.03	0.04
Computer Specialists	0.76	0.72	0.91	0.65
Computer Programmers	0.42	0.40	0.50	0.31
Computer Systems Analysts	0.32	0.30	0.34	0.30
Other Computer Specialists	0.02	0.02	0.06	0.03
Social Scientists	0.29	0.35	0.35	0.39
Economists	0.29	0.35	0.34	0.39
Other Professional and Technical	2.12	1.59	2.29	2.50
Accountants	0.90	0.56	1.08	1.59
Architects	0.01	0.01	0.00	0.00
Foresters and Conservationists	0.00	0.00	0.00	0.00
Home Management Advisors	0.00	0.00	0.00	0.00
Lawyers	0.04	0.01	0.09	0.03
Librarians	0.02	0.01	0.02	0.01
Operations and Systems Research	0.70	0.69	0.53	0.52
Personnel, Labor Relations Workers	0.41	0.27	0.47	0.27
Other Research Workers	0.06	0.06	0.09	0.08
Managers, Officials, Propr.	4.45	3.57	6.48	6.69
Buyers, Sales, and Loan Managers	1.20	1.56	1.53	2.12
Bank, Financial Managers	0.14	0.11	0.17	0.16
Credit Managers	0.02	0.03	0.02	0.01
Purchasing Agents, Buyers, Other	0.72	0.95	0.71	1.00
Sales Managers, Excl. Retail Trade	0.32	0.47	0.63	0.96
Other Managers, Officials, Proprietors	3.25	2.01	4.95	4.57
Managers, Superintendents, Building	0.00	0.00	0.00	0.00
Office Managers, Other	0.11	0.15	0.17	0.22
Other Managers, Administrators	3.13	1.85	4.77	4.34

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Table 12. United States--Selected Occupations as Percent of Total Employment of Selected Industries: (1978 and Projected 1990)

Occupation	Pipelines 1978	Pipelines 1990	Electric Services 1978	Electric Services 1990
Professional and Technical	16.95	18.08	13.27	12.08
Engineers, technical	3.72	3.56	5.87	5.70
Aeronautical Engineers	0.00	0.00	0.00	0.00
Chemical Engineers	0.27	0.19	0.07	0.05
Civil Engineers	0.53	0.53	0.48	0.41
Electrical Engineers	1.00	1.07	4.25	4.15
Industrial Engineers	0.25	0.23	0.21	0.23
Mechanical Engineers	0.74	0.58	0.60	0.60
Metallurgical Engineers	0.00	0.00	0.01	0.01
Mining Engineers	0.00	0.00	0.00	0.00
Petroleum Engineers	0.46	0.55	0.00	0.00
Sales Engineers	0.00	0.00	0.08	0.06
Other Engineers	0.48	0.42	0.17	0.19
Life and Physical Scientists	0.19	0.23	0.20	0.18
Agricultural Scientists	0.00	0.00	0.02	0.00
Atmospheric and Space Scientists	0.00	0.00	0.00	0.00
Biological Scientists	0.00	0.00	0.02	0.02
Chemists	0.12	0.09	0.11	0.12
Geologists	0.07	0.14	0.02	0.03
Marine Scientists	0.00	0.00	0.01	0.00
Physicists and Astronomers	0.00	0.00	0.02	0.02
Other Life and Physical Scientists	0.00	0.00	0.00	0.00
Mathematical Specialists	0.08	0.11	0.07	0.05
Actuaries	0.00	0.00	0.00	0.00
Mathematicians	0.00	0.00	0.01	0.00
Statisticians	0.08	0.11	0.05	0.05
Computer Specialists	1.08	0.96	0.57	0.50
Computer Programmers	0.77	0.71	0.39	0.35
Computer Systems Analysts	0.31	0.25	0.15	0.13
Other Computer Specialists	0.00	0.00	0.04	0.02
Social Scientists	0.34	0.29	0.26	0.22
Economists	0.34	0.29	0.26	0.22
Other Professional and Technical	6.58	7.75	2.57	1.78
Accountants	4.32	6.23	1.54	1.15
Architects	0.00	0.00	0.03	0.02
Foresters and Conservationists	0.00	0.00	0.04	0.01
Home Management Advisors	0.00	0.00	0.13	0.13
Lawyers	0.63	0.36	0.19	0.09
Librarians	0.00	0.00	0.00	0.00
Operations and Systems Research	0.35	0.26	0.17	0.13
Personnel, Labor Relations Workers	1.17	0.83	0.44	0.25
Other Research Workers	0.11	0.06	0.03	0.01
Managers, Officials, Propr.	9.94	10.60	5.78	6.34
Buyers, Sales, and Loan Managers	1.73	1.83	0.84	0.83
Bank, Financial Managers	0.25	0.31	0.10	0.07
Credit Managers	0.00	0.00	0.05	0.04
Purchasing Agents, Buyers, Other	1.42	1.43	0.54	0.56
Sales Managers, Excl. Retail Trade	0.07	0.09	0.15	0.17
Other Managers, Officials, Proprietors	8.21	8.77	4.94	5.51
Managers, Superintendents, Building	0.00	0.00	0.03	0.03
Office Managers, Other	0.71	0.64	0.48	0.64
Other Managers, Administrators	7.48	8.14	4.43	4.82

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Table 12. United States--Selected Occupations as Percent of Total Employment of Selected Industries: (1978 and Projected 1990)

Occupation	Comb Electric Gas & Other 1978	Comb Electric Gas & Other 1990	Natural Gas & Steam Systems 1978	Natural Gas & Steam Systems 1990
Professional and Technical	12.90	13.27	9.73	9.06
Engineers, technical	4.24	4.50	1.95	2.15
Aeronautical Engineers	0.00	0.00	0.00	0.00
Chemical Engineers	0.08	0.10	0.14	0.18
Civil Engineers	0.33	0.37	0.27	0.30
Electrical Engineers	2.43	2.44	0.22	0.23
Industrial Engineers	0.17	0.24	0.25	0.25
Mechanical Engineers	0.67	0.77	0.54	0.60
Metallurgical Engineers	0.00	0.00	0.01	0.00
Mining Engineers	0.00	0.00	0.00	0.00
Petroleum Engineers	0.01	0.00	0.09	0.10
Sales Engineers	0.10	0.09	0.09	0.11
Other Engineers	0.46	0.51	0.34	0.38
Life and Physical Scientists	0.17	0.25	0.15	0.20
Agricultural Scientists	0.00	0.00	0.00	0.00
Atmospheric and Space Scientists	0.00	0.00	0.00	0.00
Biological Scientists	0.02	0.01	0.00	0.00
Chemists	0.10	0.14	0.05	0.03
Geologists	0.02	0.05	0.10	0.17
Marine Scientists	0.03	0.04	0.00	0.00
Physicists and Astronomers	0.00	0.00	0.00	0.00
Other Life and Physical Scientists	0.00	0.00	0.00	0.00
Mathematical Specialists	0.09	0.10	0.08	0.08
Actuaries	0.00	0.00	0.00	0.00
Mathematicians	0.00	0.00	0.01	0.00
Statisticians	0.09	0.10	0.07	0.08
Computer Specialists	0.82	0.73	0.82	0.70
Computer Programmers	0.48	0.45	0.59	0.53
Computer Systems Analysts	0.32	0.27	0.20	0.16
Other Computer Specialists	0.02	0.01	0.04	0.02
Social Scientists	0.33	0.31	0.39	0.36
Economists	0.32	0.31	0.39	0.36
Other Professional and Technical	3.10	2.85	3.35	2.19
Accountants	1.80	1.94	2.05	1.31
Architects	0.04	0.03	0.00	0.00
Foresters and Conservationists	0.00	0.00	0.00	0.00
Home Management Advisors	0.09	0.09	0.10	0.02
Lawyers	0.35	0.20	0.37	0.26
Librarians	0.00	0.00	0.00	0.00
Operations and Systems Research	0.26	0.26	0.21	0.16
Personnel, Labor Relations Workers	0.53	0.31	0.58	0.42
Other Research Workers	0.03	0.02	0.05	0.02
Managers, Officials, Propr.	5.89	6.70	8.37	9.21
Buyers, Sales, and Loan Managers	0.88	0.94	1.04	1.23
Bank, Financial Managers	0.11	0.09	0.12	0.11
Credit Managers	0.06	0.04	0.07	0.07
Purchasing Agents, Buyers, Other	0.46	0.45	0.48	0.56
Sales Managers, Excl. Retail Trade	0.25	0.37	0.36	0.49
Other Managers, Officials, Proprietors	5.01	5.76	7.33	7.98
Managers, Superintendents, Building	0.01	0.01	0.02	0.02
Office Managers, Other	0.47	0.58	0.64	0.72
Other Managers, Administrators	4.52	5.16	6.67	7.24

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Table 12. Note and Source

Note: SIC Codes for Table 12

Industry	SIC Code
Metal Mining	10
Coal Mining	11-12
Oil and Gas Extraction	13
Petroleum Refining	291
Industrial Chemicals	281
Fabricated Structural Metal Products	344
Engines and Turbines	351
Other Electrical Machinery	361,362,364,367
Pipelines	46
Electric Services	491
Combination Electric, Gas, and Other	493
Gas and Steam Supply Systems	492,496

Source: U. S. Department of Labor, Bureau of Labor Statistics, The National Industry-Occupation Employment Matrix, 1970, 1978, and Projected 1990, Volumes I and II (April 1981).

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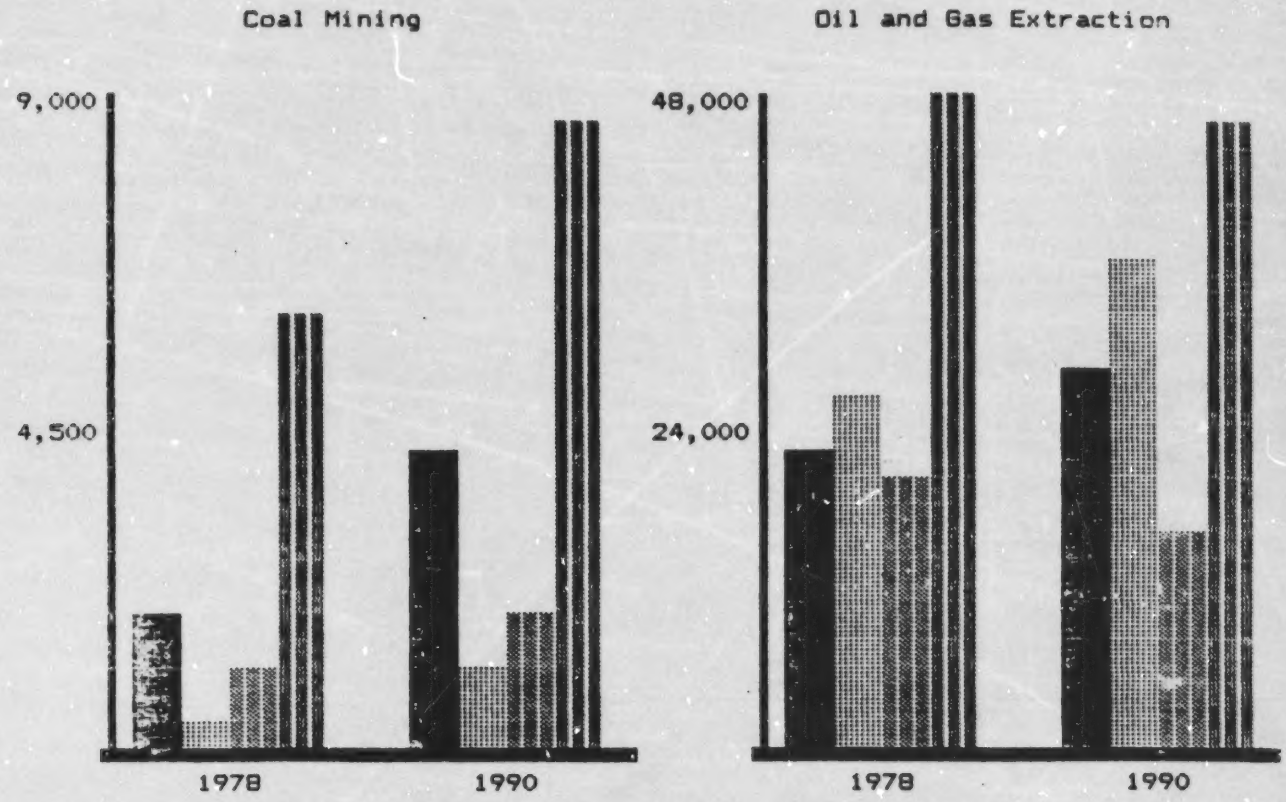
Figure 4. Number of Employees in Selected Occupations for Selected Industries: 1978 and Projected 1990



= Engineers, technical

= Life and physical scientists, mathematical specialists, computer spcecialists, and social scientists.

= Other professional and technical (see Table 12 for specific occupations)

= Managers, Officials, & Prorietors (see Table 12 for specific occupations)

Source: U.S. Department of Labor, Bureau of Labor Statistics, The National Industry-Occupation Employment Matrix, 1970, 1978, and Projected 1990, Volumes I and II, (April 1981). Graph based upon data derived by multiplying employment estimates in source document by percentages from Table 12.

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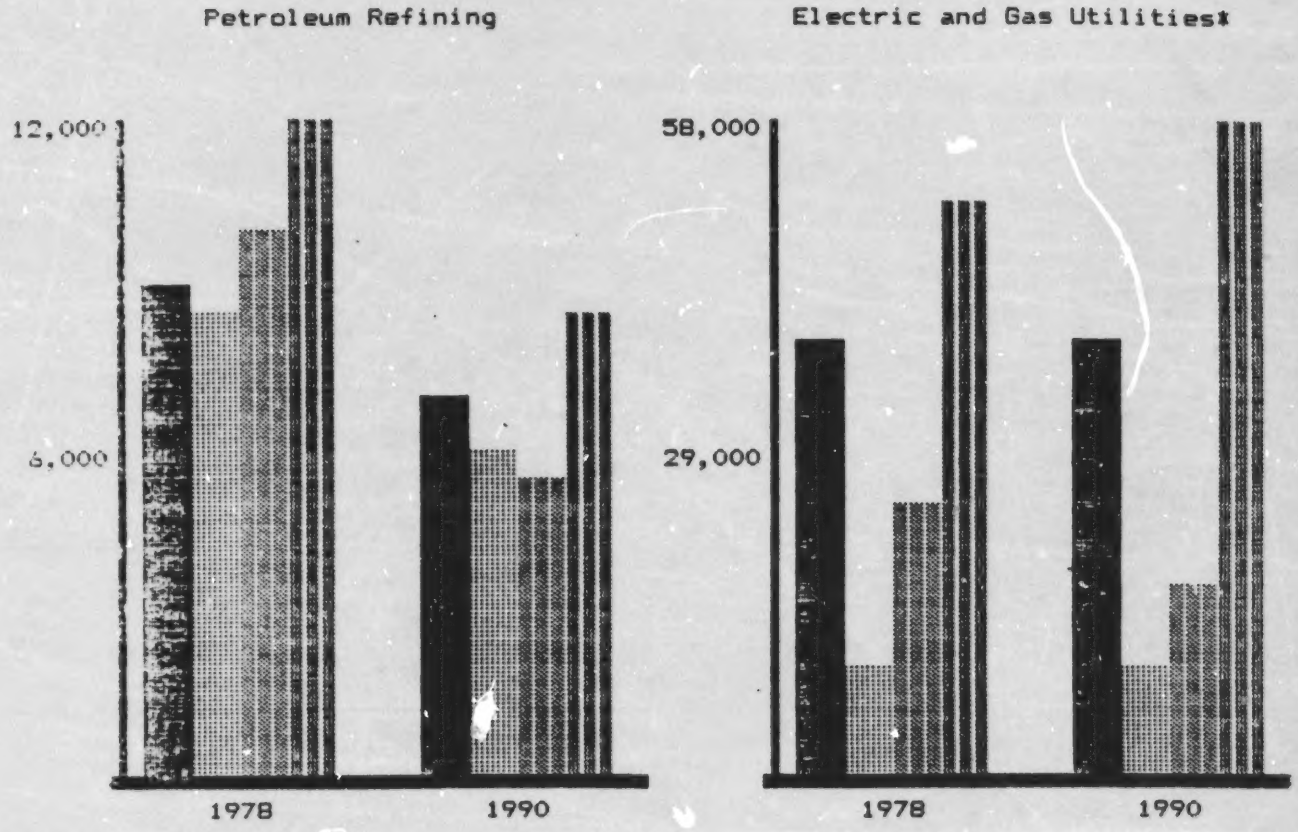
Figure 4. Number of Employees in Selected Occupations for Selected Industries: 1978 and Projected 1990



*Includes steam supply systems

= Engineers, technical

= Life and physical scientists, mathematical specialists, computer spcecialists, and social scientists.

= Other professional and technical (see Table 12 for specific occupations)

= Managers, Officials, & Prorietors (see Table 12 for specific occupations)

Source: U.S. Department of Labor, Bureau of Labor Statistics, The National Industry-Occupation Employment Matrix, 1970, 1978, and Projected 1990, Volumes I and II, (April 1981). Graph based upon data derived by multiplying employment estimates in source document by percentages from Table 12.

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Table 13. United States--Employment by Selected Occupations: 1980 and Projected 1990(Two Alternatives)

(Thousands)

Occupation	1980	Projected 1990 (Low)	Projected 1990 (High)	Percent Change 1980-1990 (Low)	(High)
Total, All Occupations	102,107.3	119,591.1	127,908.4	17.1	25.3
Professional, Tech. & Kind Occup.	16,395.2	19,662.3	20,727.6	19.9	26.4
Engineers	1,177.8	1,504.3	1,624.3	27.7	37.9
Aero-Astronautical Engineers	68.0	97.6	103.6	43.5	52.4
Chemical Engineers	55.5	68.4	73.1	23.2	31.7
Civil Engineers	165.4	207.9	217.2	25.7	31.3
Electrical Engineers	326.7	441.2	479.9	35.0	46.9
Industrial Engineers	115.9	145.7	159.3	25.7	37.4
Mechanical Engineers	212.9	273.9	300.0	28.7	40.9
Metallurgical Engineers	15.4	20.4	22.0	32.5	42.9
Mining Engineers	6.1	8.4	9.2	37.7	50.8
Petroleum Engineers	17.9	26.0	27.6	45.3	54.2
All Other Engineers	193.9	214.6	232.5	10.7	19.9
Life & Physical Scientists	253.8	300.2	317.3	18.3	25.0
Agricultural Scientists	19.8	21.6	22.7	9.1	14.6
Biological Scientists	44.8	51.2	54.1	14.3	20.8
Chemists	93.6	112.9	119.5	20.6	27.7
Geologists	39.8	51.7	54.9	29.9	37.9
Medical Scientists	8.1	9.4	9.7	16.0	19.8
Physicists	20.5	23.1	24.4	12.7	19.0
All Other Life & Phy. Scient.	27.1	30.3	32.0	11.8	18.1
Mathematical Specialists	52.0	61.7	65.8	18.7	26.5
Actuaries	7.8	10.9	11.6	39.7	48.7
Mathematicians	12.7	14.4	15.2	13.4	19.7
Statisticians	26.5	30.9	33.2	16.6	25.3
Computer Specialists	432.8	683.1	733.9	57.8	69.6
Computer Programmers	228.2	339.9	366.0	48.9	60.4
Computer Systems Analysts	204.6	343.2	367.9	67.7	79.8
Social Scientists	189.6	242.4	255.4	27.8	34.7
Economists	28.8	40.9	43.3	42.0	50.3
Other Professional,Technical	4,445.7	5,248.7	5,559.9	18.1	25.1
Accountants & Auditors	833.2	1,033.9	1,131.4	26.5	35.8
Architects	79.5	105.5	112.1	32.7	41.0
Foresters	29.5	32.2	33.6	9.2	13.9
Lawyers	416.2	523.5	579.9	25.8	39.3
Librarians	134.3	138.5	141.1	3.1	5.1
Personnel, Labor Relations Spec	178.2	205.1	217.2	15.1	21.9
Managers, Officials & Proprietors	9,355.4	10,562.5	11,344.1	12.9	21.3

Source: U.S. Department of Labor, Occupational Projections and Training Data. (December 1982).

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Table 14. Tennessee--Employment and Openings by Selected Occupations: Estimated 1984 and Projected 1990

Occupation	Estimated 1984	Projected 1990	Percent Change	Annual Job Openings Due to Growth
Total, All Occupations	2,070,150	2,251,390	8.8	30,206
Professional, Technical & Kind Occup	288,630	312,680	8.3	4,008
Engineers	19,450	20,980	7.9	255
Aero-Astronautic Engineers	100	110	10.0	1
Chemical Engineers	1,600	1,790	11.9	31
Civil Engineers	3,020	3,080	2.0	10
Electrical Engineers	4,180	4,640	11.0	76
Industrial Engineers	3,040	3,340	9.9	50
Mechanical Engineers	4,410	4,780	8.4	61
Metallurgical Engineers	180	190	5.6	1
Mining Engineers	40	50	25.0	1
Other Engineers	2,900	3,020	4.1	20
Life & Physical Scientists	3,450	3,670	6.4	36
Agricultural Scientists	210	200	-4.8	---
Life Scientists	360	390	8.3	5
Biological Scientists	310	320	3.2	1
Chemists	1,360	1,470	8.1	18
Geologists	130	150	15.4	3
Physicists	70	70	0.0	0
Life, Physical Scientists,nec	1,340	1,400	4.5	10
Mathematical Specialists	250	260	4.0	1
Actuaries	100	100	0.0	0
Mathematical Scientists	60	60	0.0	0
Statisticians	100	110	10.0	1
Computer Specialists	6,200	7,110	14.7	151
Computer Programmers	3,050	3,520	15.4	78
Computer Systems Analysts	3,160	3,590	13.6	71
Social Scientists	1,710	1,920	12.3	35
Economists	150	160	6.7	1
Other Professional,Technical	72,890	79,900	9.6	1,168
Accountants & Auditors	14,420	16,170	12.1	291
Architects	820	900	9.8	13
Foresters	280	240	-14.3	---
Lawyers	5,620	6,360	13.2	123
Librarians	2,330	2,330	0.0	0
Personnel,Labor Relations Spec	3,960	4,250	7.3	48
Managers and Officials	188,420	206,390	9.5	2,995

Source: Tennessee Department of Employment Security, unpublished data.
Percent change calculated from data.

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Table 15. Tennessee--Number of Employees, Payroll, and Average Wage Per Employee Per Establishment in Local Government Utilities: 1977

	Number of Employees	Payroll (Thousand Dollars)	Average Wage Per Employee
Electric Power	5,577	75,540	13,545
Gas Supply	1,567	19,104	12,191

Source: U. S. Department of Commerce, Bureau of the Census, 1977 Census of Government: Compendium of Public Employment, (July 1979).

Table 16. Tennessee Valley Authority--Number of Employees and Average Salary for Selected Occupations: 1983

Occupation	Number of Employees	Average Salary
Administrative	1,112	25,201
Engineering and Computer	3,477	35,752
Scientific and Program	65	25,643
Managers	3,965	44,014

Source: Tennessee Valley Authority, unpublished data.

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APPENDIX

STANDARD INDUSTRIAL CLASSIFICATION

10 METAL MINING
109 Miscellaneous Metal Ores
1094 Uranium-Radium-Vanadium Ores
Establishments primarily engaged in mining, milling, or otherwise preparing uranium-radium-vanadium ores.

11 ANTHRACITE MINING
111 Anthracite Mining
1111 Anthracite Mining
Establishments primarily engaged in producing anthracite or in developing anthracite mines. All establishments in the United States that are classified in this industry are in Pennsylvania.
1112 Anthracite Mining Services
Establishments primarily engaged in performing anthracite mining services for others, on a contract, fee, or similar basis.

12 BITUMINOUS COAL AND LIGNITE MINING
121 Bituminous Coal and Lignite Mining
1211 Bituminous Coal and Lignite Mining
Establishments primarily engaged in producing bituminous coal or lignite or in developing bituminous coal or lignite mines. This industry includes underground mining, auger mining, strip mining, culm bank mining, and coal cleaning, crushing, screening, and sizing plants, whether or not operated in conjunction with the mines served.
1213 Bituminous Coal and Lignite Mining Services
Establishments primarily engaged in performing bituminous coal and lignite mining services for others on a contract, fee, or similar basis.

13 OIL AND GAS EXTRACTION
131 Crude Petroleum and Natural Gas
1311 Crude Petroleum and Natural Gas
Establishments primarily engaged in operating oil and gas field properties. Such activities include exploration for crude petroleum and natural gas; drilling, completing, and equipping wells; operation of seperators, emulsion breakers, desilting equipment; and all other activities in the preparation of oil and gas up to the point of shipment from the producing property. This industry also includes the production of oil through the mining and extraction of oil from oil shale and oil sands.
132 Natural Gas Liquids
1321 Natural Gas Liquids
Establishments primarily engaged in producing liquid hydrocarbons from oil and gas field gases.
138 Oil and Gas Field Services
1381 Drilling Oil and Gas Wells
Establishments primarily engaged in drilling wells for oil or gas field operations for others on a contract, fee, or similar basis. This

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industry includes contractors that specialize in spudding in, drilling in, redrilling, and directional drilling.

1382 Oil and Gas Field Exploration Services

Establishments primarily engaged in performing geophysical, geological, and other exploration services for oil and gas on a contract, fee, or similar basis.

1389 Oil and Gas Field Service, Not Elsewhere Classified

Establishments primarily engaged in performing oil and gas field services, not elsewhere classified, for others on a contract, fee, or similar basis, such as excavating slush pits and cellars; grading, and building of foundations at well locations; well surveying; running, cutting, and pulling casings, tubes, and rods; cementing wells; shooting wells; perforating well casings; acidizing and chemically treating wells; and cleaning out, bailing, and swabbing wells.

16 CONSTRUCTION OTHER THAN BUILDING CONSTRUCTION--GENERAL CONTRACTORS

162 Heavy Construction, Except Highway and Street Construction

1629 Heavy Construction, Not Elsewhere Classified

General contractors primarily engaged in the construction of heavy projects, not elsewhere classified.

28 CHEMICAL AND ALLIED PRODUCTS

281 Industrial Inorganic Chemicals

2819 Industrial Inorganic Chemicals, Not Elsewhere Classified

Establishments primarily engaged in manufacturing industrial inorganic chemicals, not elsewhere classified.

29 PETROLEUM REFININ AND RELATED INDUSTRIES

291 Petroleum Refining

2911 Petroleum Refining

Establishments primarily engaged in producing gasoline, kerosene, distillate fuel oils, residual fuel oils, lubricants and other products from crude petroleum and its fractionation products, through straight distillation of crude oil, redistillation of unfinished petroleum derivatives, cracking or other processes.

34 FABRICATED METAL PRODUCTS

344 Fabricated Structural Metal Products

3443 Fabricated Plate Work (Boiler Shops)

Establishments primarily engaged in manufacturing power and marine boilers, pressure and nonpressure tanks, processing and storage vessels, heat exchangers, weldments and similar products by the process of cutting, forming and joining metal plates, shapes, bars, sheet, pipe mill products and tubing to custom or standard design for factory or field assembly.

35 MACHINERY, EXCEPT ELECTRICAL

351 Engines and Turbines

3511 Steam, Gas, and Hydraulic Turbines and Turbine Generator Set Units

Establishments primarily engaged in manufacturing steam turbines; hydraulic turbines; gas turbines, except aircraft; complete steam, gas, and hydraulic turbine generator set units; and steam engines.

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36 ELECTRICAL AND ELECTRONIC MACHINERY, EQUIPMENT, AND SUPPLIES
361 Electric Transmission and Distribution Equipment
3612 Power, Distribution, and Speciality Transformers
Establishments primarily engaged in manufacturing power, distribution, instrument, and speciality transformers.

46 PIPE LINES, EXCEPT NATURAL GAS
461 Pipe Lines, Except Natural Gas
4612 Crude Petroleum Pipe Lines
Establishments primarily engaged in the pipe line transportation of crude petroleum.
4613 Refined Petroleum Pipe Lines
Establishments primarily engaged in the pipe line transportation of refined products of petroleum, such as gasoline and fuel oil.
4619 Pipe Lines, Not Elsewhere Classified
Establishments primarily engaged in the pipe line transportation of commodities except crude petroleum (Industry 4612), refined products of petroleum (Industry 4613), and natural gas (Industry (4922).

49 ELECTRIC, GAS, AND SANITARY SERVICES
491 Electric Services
4911 Electric Services
Establishments engaged in the generation, transmission and/or distribution of electric energy for sale.
492 Gas Production and Distribution
4922 Natural Gas Transmission
Establishments engaged in the transmission and/or storage of natural gas for sale.
4923 Natural Gas Transmission and Distribution
Establishments engaged in both the transmission and distribution of natural gas for sale.
4924 Natural Gas Distribution
Establishments engaged in the distribution of natural gas for sale.
4925 Mixed, Manufactured or Liquefied Petroleum Gas Production and/or Distribution
Establishments engaged in the manufacture and/or distribution of gas for sale, including mixtures of manufactured with natural gas.
493 Combination Electric and Gas, and Other Utility Services
4931 Electric and Other Services Combined
Establishments primarily engaged in providing electric services in combination with other services, with electric services as the major part though less than 95 percent of the total.
4932 Gas and Other Services Combined
Establishments primarily engaged in providing gas services in combination with other services, with gas services as the major part though less than 95 percent of the total.
4939 Combination Utilities, Not Elsewhere Classified

Source: Office of Management and Budget, Standard Industrial Classification Manual, 1972.

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EMPLOYMENT OF PROFESSIONAL AND MANAGEMENT PERSONNEL IN ENERGY-RELATED OCCUPATIONS

Policy Implications

The most significant finding, as seen in Table 1, is that the U.S. has an underutilized capacity for refining crude oil resulting in the idling of some refineries on a temporary or permanent basis. The prospect for overall employment in refinery processing is not promising for the following reasons:

a. As existing refineries are remodeled to comply with environmental regulations, automation and advanced technology will reduce the need for manpower.

b. Foreign producers will develop their own refining facilities and reduce the prospect of utilizing some of the excess capacity of U. S. refineries.

c. The demand for oil will stabilize at the present level or continue to decline (because of shifts to other sources of energy or a more efficient use of existing sources) making the wisdom of pursuing of a career in refinery-related occupations questionable.

d.An excess supply of experienced manpower for different jobs in refinery processing or service will

make it economically feasible to retrain or upgrade the skills of those who are already employed (or those that were laid off from refineries) before launching an effort to introduce new people to this labor market.

The U.S. Department of Labor projects that since all the growth in the oil and gas industry for the entire decade had been reached by the Spring of 1982, it is possible to expect a decline in the total employment in this industry to a level which is about 90% of the March 1982 level. (cited by Energy Related Manpower,1982 p.13)

On the other hand, some employers wish to live up to their social responsibilities and to expand their labor force to include minorities. Employers may also prefer to hire younger employees better prepared to deal with the state of the art in technology. Although those already employed may be retrained, they may not be able to endure a subsequent retraining to meet the changing technology of tomorrow. Recent graduates, however, may have the necessary educational background to undergo several phases of retraining once they enter the labor force.

The State of Tennessee is not a hub of energy production, as Table 1 shows. Unless the distribution of energy production activities increases within the State, the state's investment in the education of students for the energy industry would not receive an adequate return as graduates move out of the state to find employment.

The U.S Department of Energy projects that by 1990 the production of both oil and gas will decline while the production of coal will experience a growth of about 30%. Such a shift may, under certain technological, economic, and environmental contingencies, redistribute energy production nationwide and increase the importance of local energy sources. Likewise, there is a heavy emphasis, both at the national and at the state level, on the use of nuclear or coal-fired facilities in future power plants, as illustrated in Table 3. The projected growth in local demand for electric power in Tennessee, as a result of growing industrial activity, may generate new demand for labor in the energy production within the State and therefore the prospect of new jobs.

A survey of research and development efforts might indicate existing trends in research and development and hence where jobs are likely to be found in the future. However, such a survey is difficult to conduct and its results may be misleading. For obvious reasons, industry is reluctant to provide more than general, abstract, and many times deliberately confusing, information about specific processes or products under consideration. The figures for overall expenditure may tell something about the research frontiers, but little about the implications for future jobs. The available data suggest that more money is spent by government and the industry on research and development of non-conventional sources of energy, according to Tables 4

and 5. However, these costs may reflect more the expensive layouts or preconditions for such research than the scope of the effort. Research on fusion, for example, involves a huge investment, but it is carried out in only a few centers. The odds for a revolutionary breakthrough and its probable influence on employment in energy within the next twenty years are very low. On the other hand, on- going research into other sources of energy may have greater influence on the nature of careers in energy, despite a lower rate of expenditure for that type of research. Numerous projects are carried out simultaniously in many places and a technological breakthrough may prove to be more readiliy available for commercial adoption than magnetic fusion.

It should be noted that DOE predicted, in its Energy Related Manpower 1982 (Dec. 1982), a decline in research and development activities between 1981 and 1983 and a new growth between 1984 and 1990. Except for civil engineering which will continue to grow through out the whole period, only in chemistry, earth sciences, chemical engineering, and petroleum engineering employment gains will be sufficient to offset the loss of Ph.D employment in 1981-1983. Some growth in employment opportunity is expected for holders of B.S. and M.S. degrees in the same fields.(1982:12)

Although the number of employees nationwide in electric services (SIC Code 491) is the second largest after oil and gas extraction, it is only the fourth in Tennessee (see Tables 8 and 9 and the corresponding figures 1 and 2). Because of the migration to the state from northern states and the effort to expand the industrial infrastructure, it is possible to assume a growing need for additional employees for such services. The Tennessee Energy Authority (now reorganized as the Energy Division of the State Department of Economic and Community Development) predicts that consumption of electricity will increase 116% to 120% between 1980 and 1989 The Tennessee Energy Profiles 1982:vii-11 . Even if such growth may indicate a potential for additional employment opportunities, advanced technology may eliminate existing jobs and reduce the need for additional manpower. Indeed, Table 12 suggests a general decline in the percentage of professionals employed in electric services by 1990.

A meaningful assessment of the total employment picture for the energy industry depends on the adequacy of manpower planning for each of the companies providing such services. At this time we do not have adequate data that is based on a company by company projection of manpower needs between now and the end of the decade. A further study of this issue is necessary given the fact that the average salary in Tennessee for employees in this category (SIC 491) is lower than the average salary in similar occupations (SIC 49) for

the rest of the country but still higher than the average salary in general or for certain other occupations in Tennessee (See Tables 10 and 11 and Figure 3). The availability of higher paying jobs out-of-state may lead to a migration of more experienced professionals. The vacancies left within the State may be available for less experienced professionals, including a larger number of minorities, if they are academically well prepared for those positions.

Conclusions

A conservative approach to training minorities for careers in energy may produce the greatest benefits. Training minorities in large numbers for undefined jobs might result in unemployment and frustration, as well as inefficient use of public funds. We should first identify specific potential for employment on a company by company basis and then create the conditions necessary to inform and prepare minority students for such employment. Cooperative arrangements of summer or year-long employment internships with energy-related companies promise the most realistic job preparation.

We should also identify the projected need for trained personnel in new capacities where companies are not bound to follow past practices, seniority, or contracts with unions. Environmental safety and energy planning offer possible future employment opportunities not developed at present.

Tennessee State University can facilitate increased employment of minorities in the energy industry through careful assessment of the existing and future employment opportunities in the state and through adequate preparation of selected students for such careers. Large numbers of graduates would not be the goal of such a program, rather carefully prepared graduates in small numbers to fill the positions available. A careful preparation will include early and adequate student advising about courses to take, in combination with short-term internship experiences in the industry. The University has the students and the faculty interested in energy. The University is ready and able to implement a program to better prepare minority graduates for careers in energy. Once the University commits to the concentrated effort to develop the cooperative agreements with industry and governmental agencies, we will have all the ingredients needed for success with this project.

Energy Education Institute

Obstacles to the Employment and Promotion of Women and Minorities in Energy and Related Industries

Submitted to: Dr. Arie Halachmi, Director

Energy Education Institute

February 1984

This paper is based on a research that was conducted for the Energy Education Institute of Tennessee State University with partial support from the Office of Minority Impact/U.S. Department of Energy. This paper does not necessarily reflect the official position or policies of the sponsors.

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INTRODUCTION

Women and Minorities In Energy Fields

Few question the assertion that there are some major obstacles to the employment of women and minorities in energy and related areas.[1] The problem seems to be the same one that they face in the work place in general: Segregation, lower wages and/or exclusion.[2]

Women. The picture for women is quite dismal. It appears that this situation has occurred and is maintained for two major reasons. First, traditionally, women have been shuffled into so called female jobs and careers. Secondly, over the last decade, the dramatic increase in the number of women entering the workforce has resulted in a large number of females in entry level positions both in the work place in general and in energy and related areas in particular.[3]

Regardless, there appears to be little justifiable reason why women are found in such sparse numbers in energy related fields. Consider the following. A fairly recent study found that women, who accounted for slightly less than thirty percent of engineering graduates, and 19.3% of all scientists and engineers, made up less than 7% of those holding these positions in energy and related occupations.[4] Another study found a similar pattern. It indicated, relative to the same occupations, scientists and engineers, that though women received 5.9% of all doctorates in mathematics, a major criterion for success in these areas, they comprised less than 3%of those working at such positions in energy and related fields.[5]

Mary Lou Randover, National Institute of Education, Washington, D.C., recently synthesized the total picture of women being qualified to enter energy and related fields beyond the percentages that they presently occupy. She says in part, let us quote:[6]

> "In 1976, 9.1% of the students enrolled in technical education were women. By 1978, this percentage had almost doubled to a figure of 17.6%. Women in agriculture have grown from 10% in 1976 to 17.2% in 1978. This demonstrates that there is a growing pool of women who will be trained to enter energy related occupations".

Minorities. The energy employment picture for Blacks and other minorities is even more devastating than that for women. The legacy of "blocked horizontal mobility" with respect to occupations in general and energy and related fields in particular, is one of the most obvious. The energy area, though it has begun to disseminate what it feels to be the appropriate rhetoric, remains one of the worst offenders relative to the lack of minority employment and promotion.[7]

Neal H. Rosenthal, Bureau of Labor Statistics, U.S. Department of Labor supports this position with the following statement: "The energy industry which has recently discovered great concern for minorities, has just about the worst minority hiring record of any industry in America".[8]

Usual Areas of Focus For Black College Graduates

Traditionally, in the Old South, where the bulk of the U.S. Black population resides, the usual professional areas Blacks were trained for, and went into included the ministry, school teaching and medical areas. Much of this legacy remains with us today.[9]

Education. Thus, the formal training of Black professionals has tended to exclude the possibilities of being employed in energy and related industries. In many predominantly Black educational institutions, students major in areas that prepare them for employment in the human services.[10] Conversely, the areas such as chemistry, biology, mathematics, physics and engineering, that could provide training for energy related occupations are selected much less frequently as major areas.[11]

Tennessee State University Education Leadership Role. A look at the majors most frequently selected by students at the most predominantly Black institution in the Tennessee higher education system, T. S. U., located in the city of Nashville, which also serves as the base for the Energy Institute this paper was written for, provides some additional information. According to Dr. Michael Nettles, Assistant Director for Academic Affairs, Tennessee Higher Education Commission, T.S.U. educates approximately 26% of the Black students that earn higher education degrees from the State's college and university system.[12] This involves a substantially larger percentage and number of students than any of the other institutions within the system. Hence, it was selected for review.

Tennessee State University Study of Major Areas Selected by Students. Dr. Ernest Rhodes, one of the authors of this paper, assisted by Lois McDouglad, Professor of History and Geography, recently conducted a study of the major areas of focus for recent graduates. The study involved students who graduated from 1978-1980. The purpose of this study was to determine whether Blacks were still majoring in large numbers, in the so-called

soft areas, as opposed to endeavors that might better prepare them for work in energy and related fields.

Three areas were delineated within the School of Arts and Sciences to serve as a focal point, the Natural Sciences, Social Sciences and the humanities. Once these areas were articulated, a random survey was conducted. A sample of 604 subjects was obtained. The data collected is carried in Table I. These data seem to suggest that the Social Sciences are still the disproportionate choice of a sizeable portion of the Blacks who graduate, with higher education degrees, from public colleges and universities in Tennessee.[13] Therefore, a sizeable portion of Blacks who receive higher education degrees may be ill prepared to initially enter into energy and related work areas.

Table I

T.S.U. Arts and Sciences Graduates -	1978	1979	1980	Percent of Total
NATURAL SCIENCES, N = 142	45	53	44	23%
SOCIAL SCIENCES, N = 319	119	112	88	53%
THE HUMANITIES, N = 143	44	48	51	24%

While overgeneralization of these statistics is not intended, it seems safe to assume that this trend is repeated in several of the predominantly Black state universities in the original 17 states of the Old South, where a large percentage of Black youth are trained and educated today.

How Do We Increase The Levels Of Participation Of Women And Minorities In Energy And Related Industries?

At this juncture, given the low level of participation for minorities and women, in energy and related fields, the central question focuses.

What can and/or what should be done to correct this lack of participation by women and minorities in energy and related fields?

William L. Smith, then the U.S. Commissioner of Education, Dept. of Health, Education and Welfare provides an appropriate starting point. He suggested that:[14]

> First we must demonstrate to our nation's young people - particularly those in minority populations - that a better education can mean better jobs and fuller participation in our national life. Second, we must assure ourselves that in carrying out the first task, we will also meet the nation's work force requirements, which are affected almost daily by the increasing complexity of the energy crises.

Though the direction of focus provided by the foregoing writer seems on target, before continuing, perhaps it might be more appropriate to discuss the current status of the workforce and related matters in energy areas. This approach would seem justified because any efforts aimed at increasing the proportion of minorities and women in energy and related fields must necessarily be proceeded by a determination of the nation's current and projected energy manpower needs. In short, before appropriate areas and levels of women and minority participation, in energy fields can be determined, one must know what jobs are available against projected growth and/or possible decline in these areas. Otherwise, there will be the risk of preparing a large number of people for few jobs and/or for jobs that may not exist.

Problems of Assessing Manpower Needs in Major Energy Areas. Some of the energy areas that are of primary concern include: petroleum, coal mining, liquid gas, electric and gas utilities, solar energy, synthetic fuels and

nuclear energy and so forth. Moreover, there must be a concern for exploration, and where appropriate, research and development activity, production, transportation, etc. if one is to accurately project current and future energy workforce needs.

Current Workforce Needs in Energy Areas. Determining the current and future energy needs for the United States poses a formidable task, because there appears to be no national energy policy as such, even though, some time back, Congress saw fit to create an energy department and to push for federally supported research and development in energy areas. At present, one is hard pressed to find, anywhere, a comprehensive, well articulated national energy policy that could serve as a basis for making firm estimates and/or projections concerning future U.S. energy needs. Also, determination of our current energy needs, in various areas, is effected by complex production concerns and decisions that are frequently based upon unstable political, financial and foreign affairs activity, that tend to add to the already very difficult job of focusing in on future energy needs in this critical area.[15]

And lastly, Neal Rosenthal speaking to the same topic has this to say:[16]

> The Bureau of Labor Statistics, the Department of Energy nor the Department of Labor, has tried to relate energy policy to the current employment situation. No analysis has been done which focused on measures which could ensure that those who are currently unemployed would receive jobs in new or expanding energy industries... No study has sought to relate the job potential of energy policies to employment needs of low-income people, minorities and women.

Therefore, it is not an easy matter to obtain data which allow for the determination of the exact levels of participation by minorities and women in energy and related fields. As a matter of fact, precise data, in some areas, simply do not exist. However, some data are available in

select energy employment fields, while in others, authoritative estimates must suffice.

Energy Workforce Data. Those employed in energy areas, in America, accounts for about 1.6% of the total workforce. Since the mid-1950's, there have been some ups and downs relative to shifts in U.S. energy production and use.[17]

Coal, Liquid and Natural Gas. Coal mining declined sharply from 1958-67, then experienced a dramatic increase up through 1977. The production and usage of liquid and natural gas (extraction) and all crude petroleum production followed a similar pattern.[18] There was a period of sharp decline from the early 1970s, then production and usage began to increase. Employment in these areas increased about 70% between the mid and late 1970s, while electric utilities experienced a slight growth up to 1977 and then leveled off.[19] On the other hand, gas utilities employment levels remained at the same plateau in 1977, as was the case for 1958.[20]

Nuclear Energy. The growth of nuclear energy-related activity has grown at a faster rate than the total U.S. economy. Nuclear related firms grew 145% between 1969-1978.[21]

The actual numbers involved in the nuclear workforce seem equally as impressive. According to the U.S. Department of Labor, as of 1976, just under 190,000 persons were employed in the nuclear energy industry in the United States. These persons were involved with work on-going at approximately 71 nuclear plants, with fifty more under construction, and many more planned.[22]

Solar Energy. Another energy source that holds promise of increased employment levels involves solar activity. It has been estimated that

about 22,500 worked in this area in 1978.[23] At that juncture, an 86% increase was projected in this workforce by 1981.[24] Other projections include a 144% increase in Research and Development activity by 1983.[25] Moreover, in the commercial area, estimates were for a 203% increase by this same date.[26] It is important to note that a search of the literature uncovered no data on the subsequent accuracy or inaccuracy of the above projections.

Transportation. Some other related industries also show promise of employment increases relative to energy workforce needs. One of these is transportation. The rail transportation workforce was projected to increase, because of coal and other energy production, by 6,000 workers per year during the entire decade of the 1980s.[27] Furthermore, transportation employment related to the distribution of oil and gas production was also projected to increase substantially by 1985.[28]

Overall, energy and related employment is projected to increase about 14%, between now and 1990, while the rest of the employment force is scheduled to increase by about 28.8%.[29] The area of the greatest projected growth, is the coal industry, which is expected to increase about 50%.[30] But as noted previously, employment increases in other energy related activity is projected to undergo only moderate growth. These areas include construction of power plants, solar activity, coal liquefaction, geothermal and other energy sources. These are the prospects, now for possible solutions to the central problem of restricted minority and women involvement in these fields.

Strategies For Change

Perhaps the major shortcoming of American public education is that it does not adequately prepare individuals for opportunities that open jobs up in the various areas of the job market. To the extent that this is true in general, it seems likely to be at the very least, equally as true within energy and related industries.

In supplying the needed skilled workforce for energy job fields, the educational community has a formidable task, if the goal is really to: insure the most qualified and adequate workforce now and in the future, while lessening the barriers that have prevented women and minorities from obtaining a larger portion of the available jobs in these sectors.

When attempting to develop an approach or scheme that will increase the levels of participation by women and minorities within the energy area one should keep a couple of things uppermost in mind. The question must be asked, are the training needs of the vast majority of those engaged in energy and related work different from those in other industries? The answer to this question is no.[31]

Most of those currently working in energy fields possess training that is no different from workers doing comparable jobs in other industries. The training for positions such as clerical and sales workers, accountants, laborers and truck drivers account for the majority of the employees in energy producing industries.[32] So energy employment training, in this regard, is not an impossible task. On the other hand, there is certainly a need for some specialized training. Neal H. Rosenthal, Bureau of Labor and Statistics U.S. Department of Labor recently spoke to the need in this area:[33]

> Clearly the training of some is different and specialized training is necessary. The question that needs to be answered here is what are these fields, how large is the prospect for training so specialized programs are not set up which train workers far in excess of the number that can obtain jobs.

All this notwithstanding, the consensus of authoritative opinion appears to focus upon education and training as the areas that provide the solution which hold the most promise of success. As a matter of fact, some legislation has been enacted which tends to underscore education as the tool that can be utilized to appropriately deal with this problem. The Vocational Act of 1976 is a case in point. This was the first time that there was a specific emphasis placed on energy related issues, requiring that funds be spent in emerging energy occupational areas.[34]

Also, we must be cognizant of the fact that meeting energy workforce needs, while attempting to prompt appropriate levels of participation by minorities and women, now and in the future, is not solely a federal responsibility. The States must also do their part if this effort is to be successful. Toward this end, some States are beginning to deal in a serious way with energy related topics in vocational educational areas.[35]

Though this is a long overdue positive involvement, it seems to these authors that the type of curricula change needed and suggested by such activity stands little chance of succeeding unless teacher education is also focused upon. Teaching personnel should be retrained and/or trained to deal with these relatively new energy enterprises. Therefore, we are of the opinion that it would not be fruitful to focus <u>solely</u> upon <u>these new areas</u> to the exclusion of curricula and teacher preparation processes.

The present curricula in all occupational areas must be modified and remodeled with respect to skill training practices throughout the entire formal education process in this country.

There are no pat answers about how to accomplish these goals. Nor is there an easy way out. The solution appears to lie in an extensive energy education program. Such an effort should span from the elementary beyond the post secondary level. Energy education should be broad in scope. Moreover, when and where possible, it should be integrated into the existing curriculum.

An Informed Public. If this situation is to be handled in such a way, that maximal benefits are derived, the American public must first be sensitized to the basic facts surrounding energy production and its use as related to employment needs and practices. At present, this does not seem to be the case. Americans must be made to understand that the under utilization of certain segments of the energy workforce demands and collects a high price from this society, in terms of, less efficiency and productivity and more social and class unrest.

The problem is that many Americans have never really considered the ramifications of such practice and/or they ignorantly see no personal harm in them. The key to this delimma rest in the hands of those who guide our educational institutions. Educators and administrators are the people who can sensitize and prepare U.S. citizens to be more accepting of needed changes in this area.

One writer, somewhat less directly, recently synthesized this overall point of view. He put it this way:[36]

Programs at post secondary, institutions for training energy conservation and use technicians will require a technically broad base curriculum with flexibility of modular instructional materials to allow a school to "tailor" the curriculum to meet the local and/or regional needs.

Such an approach leads invariably into the area of vocational guidance. We must develop materials and approaches that place work opportunities in energy and related industries into proper prospective. This information should allow students and non-student populations to develop an awareness of opportunities in these fields versus the type of training requirements.

Specific Recommendations

1. The public schools should include energy related topics in the curriculum at every educational level. Preferably this material should be integrated into the existing curriculum rather than fighting new curriculum battles.

2. Measures, strategies and/or approaches should be designed to increase the inter and intra-state levels of communication with respect to energy related educational activity occurring in public education.

   In this way, state and local officials will be able to design and tailor programs that meet their specific needs for skilled personnel in energy areas.

3. Policy makers should enact laws that prompt those within institutions of higher education to develop and/or modify existing teacher training programs so as to train prospective teachers or to retrain those already in the field to be more effective and efficient in teaching energy matters.

4. Key personnel from the educational agencies within this State should develop ways and methods whereby energy education efforts can be enhanced.

5. Policy makers, in conjunction with educational agencies throughout the State, should develop a comprehensive plan including funding for the development of energy education programs that will help to meet the State's manpower needs in energy and related industries.

6. Politicians, through tax incentive and other methods, should attempt to influence energy and related industry employers to get on with the job of identifying their future needs, as well as clearly describing the tasks involved at all levels of energy related industrial processes, so that appropriate skills and competencies can be taught at education and training institutions.

7. Partnership participants, (energy employers, educational institutions and students) should develop exemplary model energy workforce programs so that this information can be disseminated on a state-wide basis.

8. Partnership participants should develop and/or sponsor forums, workshops etc., at the federal, state, and local levels to develop an awareness among individual citizens and citizen groups about the need for preparing for jobs in energy and related areas.

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ENERGY EDUCATION INSTITUTE

COOPERATIVE DEVELOPMENTAL ENERGY PROJECT

TENNESSEE STATE UNIVERSITY

STEERING COMMITTEE MEETING

JANUARY 10, 1984

TSU-DOWNTOWN CAMPUS

M I N U T E S

The Cooperative Developmental Energy Steering Committee convened for a working breakfast at 7:30 a.m., January 10, 1984, at TSU's Downtown Campus. Chairman Francis Guess called the meeting to order and welcomed all in attendance. Those attending were: Mr. Isiah Sewell, Dr. Arie Halachmi, Dr. Peter Consacro, Mr. Chuck Howell, Mr. Lee Muntz, Mr. Bob Gardner, Mr. Steve Norris, Mr. Tom Green, Mr. Leslie Enoch, Mr. Ken Nye, Dr. Ed Cullum, Dr. John Crothers, Dr. James Farrell, Mr. Walter Hunt, Ms. Dorothy Lockridge, Dr. Mohan Malkani, Dr. John Masten, Dr. Wendolyn Bell, Ms. Laura Purswell, and Ms. Betty Cochran.

The minutes of the October 18, 1984, Steering Committee meeting were approved as mailed to members. Chairman Guess shared with the committee his commitment to and encouragement for this project to be housed and conducted through the auspices of Tennessee State University's Energy Education Institute, not only in his position in state

government, but also as an alumnus of TSU. He stated that he had shared with the Governor an overview of this project and that the Governor sent his best wishes and encouragement.

Dr. Halachmi presented an up-to-date report on the progress of the project. Attention was focused on the meeting packets containing:

* A resolution that was adopted by the Tennessee Legislative Black Caucus which will be considered in the General Assembly during this legislative session. The project will then have the endorsement of the state assembly for the basic objectives of this effort.

* A flyer which was distributed in an effort to collect information for the purpose of the final report and also the registration form which is being provided to students to encourage them to indicate attendance at the energy career symposium scheduled for February 24, 1984, at Tennessee State University.

* A position paper developed by Dr. Halachmi on directions and purposes of the Cooperative Developmental Energy Project.

* A brochure describing the project.

Dr. Halachmi reiterated that the constituencies the project is seeking to serve are students enrolled in higher education. Dr. Halachmi then turned the meeting over to Mr. Isiah Sewell, Program Manager from the Department of Energy in Washington, to share with the committee the thinking in Washington--how DOE sees the future of the project and what the expectations are as far as the subsequent findings and subsequent development of the project.

The following related points were made by Mr. Sewell:

* The office he works in is the Office of Minority Economic Impact which is an advisory office to the Secretary of the Department of Energy.

* As an advisory office, the purpose of this office is to develop recommendations to the Secretary which would improve institutional and minority business participation in energy activities nationwide.

* This office was established because of the lack of participation by minority educational institutions in main line R & D activities within the Department of Energy. Mostly, the research work or grants done by minority institutions fall into the support service areas and not into the hard, basic R & D energy sciences and engineering activities.

* The Cooperative Developmental Energy Program was developed and designed to be the primary leading edge of joint agreements between minority businesses, private businesses, and educational institutions where they would develop for themselves the type projects they feel would develop into long-lasting relationships between the institution and the industry. The program was designed into phases with the Department of Energy funding primarily the first phase, which is the phase that will allow the "partners" to get together and work out for themselves what type of arrangements they feel would be profitable. The emphasis in the first phases, from the Department of Energy's standpoint, is to assure that the participating partners, the members of industry, the members of the minority business community and the members of the minority institution, get a good feel and feel comfortable among themselves in developing options that would be mutually profitable over a long period. During the first phase, the participating partners are to come up with a list of one or more recommendations with which they are ready to go forward.

* The Department of Energy is in a position to participate to some degree in the second phase of the project. The amount of funding would be negotiated. There are funds in the FY85 budget for the four Phase I schools who are "competing" for the amount of Phase II funding. The level of the Phase II funding is not certain, but is sufficient to provide limited funding to 2 or 3 of the four schools.

* Funding prospects are good if one or more of the schools developed programs that were ready to move in FY84.

* The Department's position is that they are looking for projects that would develop a joint relationship between industry, whether it is minority industry or non-minority, and the minority institution is geared more toward what is referred to as the program areas of DOE, rather than the support areas.

In conclusion, Mr. Sewell stated that the Cooperative Developmental Energy Program out of his office has been listed in the President's portfolio of projects that show cooperation with the private sector, so there is interest at the White House to see that the program moves forward. There is interest at the Secretary's office within the Department of Energy, and of course, there is interest at the Office Director level within the particular group of Minority Economic Impact. He felt that the program has the potential of developing into a major activity that will provide minority educational institutions and hopefully will have another round if Congress will go along with the funds for another first phase where additional schools or additional projects within individual schools can participate. This will provide the opportunity for a structurally sound Research and Development program in many of the minority educational institutions so they can attract better teachers, students, and, working with the industry, develop those projects and those ideas that will provide for long-lasting relationships. This is the focus of the program and how DOE intends to participate. The DOE

presence as the project moves into the second, third, and fourth year will probably be less and less. At that time, the partnership should be well along and the confidence level between the primary partners should be sufficient so that the federal presence would be minimal unless the partners were working on a particular project that fell into the main line R & D effort of DOE. Then the relationship of the project may not necessarily be with the Minority Economic Impact Office, but with the Assistant Secretary within DOE that would be sponsoring that particular R & D effort.

Dr. Crothers, State Director of High Technology Development, asked Mr. Sewell for his opinion in respect to this Phase I planning of the TSU project. Mr. Sewell answered that he felt there is a well-balanced advisory group that has shown a commitment to working on this project. The potential is great with respect to the participation and the representation on the Steering Committee. It has all the ingredients of being a tremendous success. The proof will be the Phase I Report and the draft of arrangements that are developed during Phase I and the amount of commitment (not to mean verbal commitment, but actual commitment of resources, time, and individual's efforts) by those participating members. This is what DOE will be looking for when a decision is made on the continuing participation by the Department of Energy and the potential for this particular project. There are enough

ingredients and resources in Tennessee for TSU to come up with one of the better cooperative programs. Not only does Tennessee State University have the resources here, but there is TVA, a major energy activity, Oak Ridge Laboratories, and other energy research activities within the state, as well as utilities, gas and electric, and others that could participate in the project.

Mr. Sewell indicated that it is very important that at the end of Phase I there be some firm commitments on one or more specific activities. That is basically what DOE will be looking to see. A firm commitment on one or more activities rather than a general commitment to seek out additional opportunities. Beyond DOE's original notions of immediate short-range sources that applied to minorities in the energy field, the program is now concerned with movement beyond that to impacting the University with continuing education and academic programming that will lead to something more than just support services for minority institutions.

Mr. Sewell stated that this is the program's goal. DOE is not against meeting short-range objectives, but what the Department would like to see is the type of relationship developed by industry in this area and the school, so that there would be a continuing relationship where the school is providing part of the research needs of the industry and the industry is providing resources to the school both in

manpower and funds to keep their educational program developing.

Dr. Halachmi asked to what extent DOE would be in a position to support the development of a Masters or Ph.D. program in an energy-related activity at the school. Mr. Sewell replied that funding could be provided, but he was not sure about the administrative commitment on a long-term basis. There is always the matter of annual appropriation. If the commitment was developed, it would be on a one-year appropriation basis. It could be long-term in that one or more of the assistant secretaries within the Department may determine that they wanted to develop a long-term working relationship with TSU. They could enter into multi-year contracts or yearly ones. It is possible to enter into multi-year contracts, not just to develop graduates, but to perform a research mission out of which graduates would come. So, in this program DOE has the flexibility to tailor it to just about anything the industry and the institution wants. DOE is not trying to force anyone into a mold. DOE is allowing TSU to work out whatever is the best arrangement for the industry and TSU. DOE can fit into that. Of course, you have to remember that there is going to be competition for the available funds. The cooperative arrangement is critical. There must be joint arrangements where an interface between the industry and the institution can be an on-going process where everyone is in a win situation. It is not a give-away or buy-out program.

Cooperation is essential in this program.

In summary, Mr. Guess gave the following outline: TSU and the Steering Committee members entered into this venture for the purpose of determining what strategies could be developed to address the shortage of minorities in energy-related industries.

(1) Bringing together a group of people next month at the energy careers symposium for the purpose of finding out why this shortage exists and what can be done to address the shortage.

(2) From there, we are looking beyond that point to determine activities which may spring from that symposium discussion in which TSU as an educational entity under the auspices of the SBR may participate. Then, the next question would be is there any interest on the part of TSU to get involved?

Dr. Crowell, Vice President for Academic Affairs, stated that TSU is very much interested in embarking on the new ideas, new concepts, and new relationships between TSU and industries. In those energy-related areas, he felt very strongly that TSU is the institution that has all the ingredients to fulfill the commitment and provide quality programs.

Dr. Peter Consacro, State Board of Regents, stated that the State Board of Regents is supportive of this type of commitment.

Mr. Guess commented that the opportunities are opening for us to look ahead and to pledge support.

Mr. Gardner stated that Shell Oil expects good people to be produced from this project.

Mr. Leslie Enoch indicated that Nashville Gas has a cooperative agreement with TSU and Tennessee Tech at the undergraduate level at present and is looking at higher levels of management to be supportive of this project's activities.

Dr. Crothers inquired as to the time frame for writing proposals. What is the likelihood that TSU could meet the mandates of the Tennessee Higher Education Commission in documenting the need for new programs or if there is a provision for an emergency approval of an experimental program? What are the constraints that TSU would have in producing all the documentation that is required for THEC to approve new arrangements?

Dr. Consacro responded that the answer to that depends upon the nature of the program that is built. If TSU were working on existing programmatic structures and simply enhancing those through new configurations, coursework, and programs, that is one thing. If TSU was beginning an

entirely new academic program, that is another problem, and the time frames vary considerably in the approval process for those two distinct structures.

Dr. Crothers asked Dr. Consacro if he felt optimistic that if a body of industrial leaders and TSU leaders, city and state leaders should band together to state that Tennessee needs something which could be provided through TSU, that we could anticipate that THEC would be responsive.

Dr. Consacro indicated he didn't want to anticipate what THEC would do, but that TSU and the SBR obviously would work with the Commission and Dr. Brown and his support staff. Dr. Consacro further remarked that TSU is an essential public institution in the Nashville area. Concerning the SBR governing body, its view is that TSU assume more and more of the research that goes hand-in-hand with being the principle public institution in this area. So in that regard, when speaking about its mission and the support that the SBR would bring to a mission-related program, it needs to be emphasized that the SBR believes that it is an essential mission, that it is a problem which should be a primary concern to public institutions in middle Tennessee.

Dr. Sewell stated that the agreement is going to be between the institution and the departments from an DOE standpoint, but in selecting Tennessee State University, of course, DOE must insure that the institution has a basis to

work with, so as a general rule, DOE would not expect the need for an entirely new program. Mr. Sewell indicated that on August 30, 1982, Dr. Humphries sent a letter to the Minority Impact Office director inquiring about the types of activities TSU felt it would like to engage in that were interrelated. Dr. Humphries wrote that the areas of research in energy-related fields at TSU would include five basic classes of research: (1) solar energy long-range goals which would cover one of the major programs (Solar renewable sources has been identified in the national energy plan as one of priority); (2) geothermal energy design, another major program in the renewable area; (3) material science, mathematics, geosciences and biological sciences impact on nuclear engineering; (4) reduction of waste in energy consumption, increasing efficiency of equipment and conversion distribution consumption through TVA, Nashville Gas and NES, and (5) characterization and identification of hazards, specifically related to transportation, and the effects of hazardous materials in the environment.

Mr. Sewell felt that, with the letter from Dr. Humphries and the general background of the University, DOE would anticipate it would not require "a major new effort" particularly if the programs in which industry has an interest fit under any of these five areas which are broad areas and pretty important in the energy field and to DOE. DOE is in a "negotiating position" with TSU. TSU competed in the initial phase of the process and therefore has

already met the competitive criteria. From this point forward, the relationship between DOE and TSU is on a negotiating basis, which means there are no cut points where a decision must be made. The time period becomes one of funding more than anthing else, because DOE normally commits up to 90% of its funding for each fiscal year within the first six months.

Dr. Halachmi inquired as to how much money was involved, because he did not have that figure. Mr. Sewell responded that there is no dollar amount set aside for this activity and the reason for this is that DOE is talking about a secretarial level program where the DOE budget is available and the Secretary makes a determination based on the proposal which, armed within the Department, will fund that particular program on the level of that funding. One level down is the Office of Economic Minority Impact which as a small operational program whose mission is to stimulate and develop this interest. This office's request is low and won't be known until the President submits the budget report. The level is such, that if DOE funded 2 or 3 Phase II programs, DOE would probably be talking in the same range of funding as funded for Phase I. DOE has a $13 billion dollar budget.

Dr. Halachmi asked if we could assume that if TSU came to DOE with a program where it could justify the cost of the program that such a program would have a reasonable chance. Mr. Sewell replied that it would if such a program meets

the DOE requirements and if it is recommended by himself, as program manager, to Mrs. Douglas, the Assistant Secretary or equivalent, and if she agrees that the program is good and makes a recommendation to the Secretary.

Dr. Halachmi indicated he would like to know what kind of arrangements are feasible from the industry's point of view. What ideal R & D arrangements or student training internships are desired and affordable? This doesn't mean that there is a commitment from TVA or Shell, but what sort of arrangement should be sought, so that it will meet the requirements of DOE and also be consistant with the training, teaching, and development needs of the University.

Mr. Gardner of Shell Oil Co. indicated that there are a lot of ways the corporation can join with the University. One way might be to set up and conduct a one-two week orientation program where a student works with the corporation for just a short time with pay, to get involved and see what is going on, and to become involved in the action to introduce the student to the company. Then the student might go back the senior year and be able to relate to those things that he has been involved in and get the kind of job assignment wanted. There are all kinds of different arrangements. Mr. Gardner stated that most of the things done in his company are done at the head office level, all the recruiting is done at the head office level. In the Nashville area so many of the major oil companies

just have district or branch offices, so it is difficult to get in on the recruiting.

Dr. Halachmi asked what would be a good strategy to use to obtain mailing lists of companies that would send or receive information on R & D interests. Mr. Sewell replied that in the case of the federal government, the Federal Register is the place to find out what research grants are available. This is not available from private industry.

Dr. Halachmi asked that if the purpose of the DOE funding is to see that TSU faculty will be more involved in energy-related research, what would be the best way to find out what kind of issues energy corporations are interested in answering. Some of them are dealing in so called basic reasons in other aspects. These personnel regulations that were mentioned are the sort of things in which our faculty can participate and provide a meaningful contribution and in turn contribute to the quality of teaching on campus by involving students and so forth. The question is "What is a good strategy to combat this issue?" There needs to be some kind of communication process between the industry and the University. What would be the best process?

Dr. Wendolyn Bell, Dean of the School of Arts & Sciences, remarked that "this part of the discussion seemed to emphasize that there does not have to be twin relationships, for instance, between the University and Shell and the University and TVA. What these gentlemen have

been highlighting is that the nature of the company or the nature of the industry varies. This greatly broadens the opportunity for different kinds of arrangements. Three basic ingredients have been stated that we need: (1) preservice involvement of students; (2) a current proposal to better place students who graduate; and (3) a research component."

Dr. Masten, Dean of the School of Business, added that TSU has MBA programs at night with students from NES both part-time and full-time and students from TVA on a part-time basis. There are courses in computers, too. Dr. Masten indicated his desire to promote the part-time enrollment in this MBA program. Why can't the TSU faculty be involved in a research-related activity that is funded in the energy field at the graduate level and at the same time companies might have individuals who want to move along in the organization who need an MBA level program? They could take independent research courses which would involve assisting a faculty member in an energy-related project. It seems these kinds of arrangements need to be looked at.

Chuck Howell, District Administrator of TVA, commented that they feel lucky at TVA to have a fairly new cooperative umbrella agreement with TSU. The focus, thus far, has been on some high technology framework and there is a budding project called the "Nashville Project" that TVA is very excited about which entails start-up training, high technology training, and an incubation center for new

industry. He stated that he had high expectations that the next few years will be highly successful with this arrangement with TSU, SBR, and other parties. Mr. Howell indicated that he had used this Steering Committee assignment to go back to TVA and attempt to focus attention on the opportunity that this presents for other contractual work and that he was glad to say that, as of last Friday, it is beginning to pay off. TVA will be arranging a meeting soon with the science department and tne chief of TVA's technical program in Muscle Shoals, Alabama, to reach some type of arrangement so that TVA can do some biological testing on some of their reservoirs. From this starting point, TVA and TSU can enhance those opportunities and also look at the employment side through an existing co-op program and TVA's active recruiting in some specialities. As many know, TVA has reduced its work force the last couple of years by some 17,000 people, but there are still 37,000 people employed at TVA. There are still some employment needs. He stated that TVA has a very strong affirmative action program and that TVA is looking at these kinds of opportunities to open some doors. However, the needs are not like they were five years ago and TVA will have to be more demanding for specific skills that they can put into the work place. There are opportunities, but not by the same roads as a few years ago. He felt confident that this Cooperative Developmental Energy Project is a vehicle which TVA can use and the contractual arrangement with TSU will facilitate the continuing work between the two parties.

Ms. Dorothy Lockridge, Director of the Student Development Center, added that Dr. Halachmi had listed one item in developing relations with industry as the use of cooperative education. This was one of the reasons he had asked a representative of career development services to sit in on this committee meeting. She stated that her office was willing to work with the private sector in providing training opportunities for TSU students because of this student training point.

Dr. Malkani, Associate Dean of the Engineering School, added that he thought there was a need to go a step ahead. Right now, assurance had been sought, but that there was a need to get DOE and industry's viewpoint about the possibility of what research can be done if TSU is funded to do a project.

Mr. Sewell indicated that DOE, in developing the current Cooperative Developmental Energy Project agreement, outlined DOE's objectives. However, DOE would not want TSU and related industry to gear projects toward DOE's objectives. As pointed out earlier, it was the arrangement between the industry and the institution. If TSU's objectives don't fit DOE's, that is fine. TSU should go ahead with its objectives. DOE is large enough that there is something in DOE that could fit TSU's objectives. Don't let DOE's needs drive the agreements between TSU and industry. The needs of the two parties must drive the agreement. What DOE is looking for is structural

improvement at minority institutions so that they can compete for the routine DOE funding opportunities. Unfortunately, too often when a solicitation goes out for university grants and the proposals come in, on the selection list of 50-60 universities and colleges, few, if any, are minority institutions. DOE needs to develop programs to assist minority institutions so that they can become competitive. When the institution starts with the other efforts, it is going to build its overall capability so that when the normal DOE solicitations go out for $6 million in grants awarded for geothermal research, $40 million in high energy physics, etc, there will be some minority institutions who will receive part of these funds also. At that point, DOE will have satisfied the requirement or the need for greater participation by minorities in all of its activities.

Mr. Nye added that both Mr. Sewell and Dr. Halachmi had provide the committee with a couple of frameworks for the energy conference on February 24. The R & D relationship has at least two avenues. First, the direct relationship back and forth in terms of what each company and what faculty and staff are interested in researching jointly. Second, is the opportunity for the cooperative agreement to involve all sorts of other training efforts, such as employees with a company returning to school, TSU students enjoying some opportunities to engage with company employees at their work sites, faculty exchanges and company

employees serving as faculty members and engaging in R & D efforts on campus.

Dr. Halachmi stated that TSU is a great institution and we want to thank DOE for all its help in the past which allowed the University to compete with other institutions to develop its capacities in the area of energy education. The TSU situation resembles that of a sophisticated airplane. To show its flying capabilities it needs a runway which is long enough to bring its engines to full thrust for takeoff. It is also interesting to note that while the real potential of the airplane is only recognized when it has reached full cruising altitude, most of its fuel is consumed during the takeoff. The University needs the resources for such a takeoff from DOE. Only then can the full academic and research potential of the institution be realized.

Mr. Tom Green stated that it is the experience of Nashville Electric Service that the quality of students from TSU is improving vastly. Five years ago TSU students could not compete with students from other schools, but today they can. He suggested that the instituion make the move to do these kirds of things together to make TSU a great academic institution as well as a great football institution.

Mr. Guess expressed appreciation for every member's attendance and adjourned the meeting.

PROPOSAL FOR
A
CENTER FOR ENERGY EDUCATION
AND DEVELOPMENT

AT
TENNESSEE STATE UNIVERSITY

MAY, 1984

Submitted by
Arie Halachmi, Director
Energy Education Institute

INTRODUCTION

This proposal recommends the establishment of the Center for Energy Education and Development at Tennessee State University. The Center will be housed within the Division of Continuing Education, Extension, and Public Service of the University. The Center will have three primary missions. It will serve as the university contact point and liaison with the energy industry and those federal, state, and local agencies concerned with energy research, development, and training. The Center will provide faculty members and students with necessary information to facilitate energy-related programs of research and training which involve several disciplinary and administrative units on campus. The Center will also involve faculty and students in energy-related programs of public service and student development in the region served by the University.

The proposed Center is in line with the University's five-year strategic plan and will be instrumental as part of the overall efforts to achieve a variety of goals in the areas of research, development, public service, and student development. The Center will not change the already existing organizational structure, academic programs, or budget of the University. Rather, it will sanction an existing operation which began on a temporary basis, evolved over a period of three years, and now can be made

into an on-going organization to gather and disseminate information and to plan and implement activities related to energy research, instruction, public service, and student development. The Center would not assume the responsibilities nor replace the desire of academic departments, schools, or other administrative units to initiate and carry out energy-related projects. It would disseminate information to assure that research, training, and service opportunities are not lost or overlooked, and that those who plan to carry out a project in one area, such as research, are fully aware of the potential and the capacity of the University to accompany such an effort with related training, student development, or public service programs.

Rationale and Description of Existing Need

During the implementation of the Cooperative Developmental Energy project with Department of Energy (DOE) in 1983/84 it became evident that there are numerous entry points to the University for public and private organizations concerned with energy. Those include, among others, the Office of the President, the offices of the Vice-Presidents, the various academic school Deans, the offices of Department Heads, the Energy Education Institute, the Center for Career Development and other units in student affairs. Various energy-related organizations and companies may contact one of these entry points and inform the

University of possibilities for financial aid to students; research proposals sought from our faculty; internships and cooperative-education work arrangements for students; summer employment opportunities for students and faculty; or the availability of grants to provide or to cooperate with other organizations to provide education, economic development, research, or training services to the community.

Under the existing arrangements, each university office is free to take any action it deems necessary with little or no coordination with other administrative or academic units. If the office receiving information happens to hold a salient interest in this area, the response may be extremely positive. However, if, upon receiving the communication, the office is overloaded with work that takes a higher priority, the project may receive less than the utmost attention or the office may fail to refer it to another unit for its consideration or collaborative effort. The University may lose an opportunity to enhance the welfare of its students, faculty, or its financial affairs because of this uncoordinated approach. Recently an office iof the University received a request from an industrial company for a student to fill a summer internship, but due to various year-end activities, the response to that request was delayed. As a result a Tennessee State University student did not receive the internship. Likewise, following the Symposium on Energy Careers for Minorities held in February,

1984, several corporations approached the University about student employment. The university offices contacted were either unable to respond in a timely fashion, or failed to communicate the information to other offices better equipped to respond. The loss of summer employment for University students may mean a loss in enrollment the next fall, in addition to future losses in job placement opportunities for graduates, eventual alumni support, and possible research, training, or service contracts with these corporations. It is counter-productive for the University to encourage industry to cooperate at special conferences and through other special projects while isolated offices of the University discourage these associations by long delays or total lack of response to industry interests in cooperative agreements.

Outside organizations and agencies cannot always identify the "right" office to which to address their communications. Each office is not, nor can it be, fully informed about research, consulting, training, and interests of faculty and students in other university units. Each unit tends to guard its own self interests, causing the University to miss important opportunities for growth and development. The approaching company may interpret a delayed response as a basic lack of enthusiasm or interest on the part of the University as a whole. If an organization is greeted with discouragement on its initial contact, it is unlikely that it would make a serious second

attempt. When future opportunities arise, the University may not be considered at all. For example, TVA awarded a grant to another state university in the region to establish a center for energy and environment and in another case awarded a grant that was earmarked for support of an historically black institution to a black institution which is not even in the region served by TVA. A possible explanation for this action is that TVA's officials received the wrong impression about the University's interest in energy and environmental education from a much earlier energy-related project with the University which did not get off the ground. In general, though, organizations like TVA need to have one point of contact with the institution where they can be assured of responsiveness and accountability relative to their interests.

By establishing the Center for Energy Education and Development, Tennessee State University will create a clearing house for all the information that is reaching or leaving the campus about energy-related activities. Since the Division of Continuing Education, Extension, and Public Service is a planning, development, and service unit which works with all academic schools and administrative units, the Center will be housed in the institution's organization where it can encourage interdisciplinary cooperation among the academic schools, their departments, and other university units. In this capacity the Center will permit the University to better respond to any emerging

opportunity. The Center will provide external bodies with a clear point of contact to approach the University about energy-related activities and ideas. It will provide the University with an effective mechanism to disseminate such information to all the administrative and academic units or faculty and students that can assist the University in taking advantage of emerging opportunities. By alerting individual faculty members, administrative and academic units, and the student body to options, and by facilitating contacts with the community, industry, and government, the Center will enhance the University's ability to meet its objectives in the areas of research, training, public service, and student development. In particular, the Center will assure an in-house monitoring of all opportunities and promote a follow-up process to assure that no opportunity related to energy will be missed.

Current research on successful cooperation between industry and academia emphasizes the importance of the personal contacts among individuals of both parties. The Center will allow the University to continue to develop and to expand these personal contacts between its faculty and staff and the personnel of various energy-related agencies and organizations. Personalizing the nature of the contacts with these organizations will create even more opportunities for the University in research, training, public service, and student development.

Organization, Missions, and Funding

The attached diagrams provide a graphic summary of the conceptual approach for organizing the Center's functions and relationships with industry, governmental agencies, and the community. Each of the three circles in diagrams 2 and 3 represent an area of activities and sub goals. The three areas -- research, training/instruction, and service -- correspond to the main objectives of TSU as a public and an urban, land-grant university. The different activities and the sub-goals within each of those areas are not independent of each other. As indicated by the various arrows, the activities which work toward the subgoals in each area benefit and facilitate the activities and the achievement of the goals in the other two. In many cases the relationship of the different activities may be synergistic. Therefore, the integrative administrative structure of the Center will produce more effective and efficient action than the currently existing fragmented approach. For example, if the University planned a public service project on energy conservation, it would also develop the in-house expertise of the faculty through targeted research, academic credit and non-credit teaching activities, training, and student development opportunities. Faculty would also involve their students in their on-going research, thereby encouraging them to consider energy-related careers. Each program will combine achievements in instruction, research, and service.

DIAGRAM 1

ORGANIZATIONAL DIAGRAM

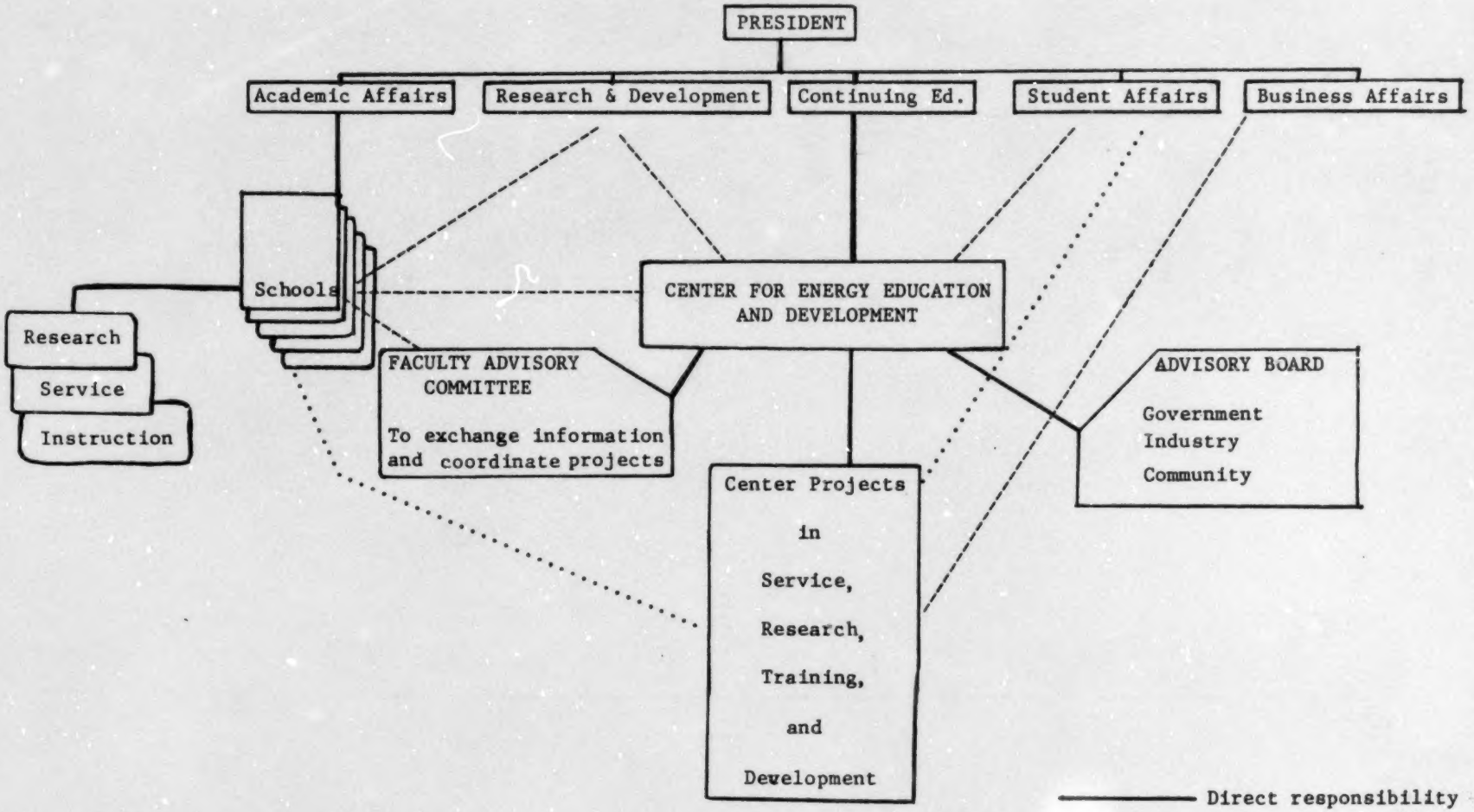


DIAGRAM 2

CONCEPTUAL DIAGRAM

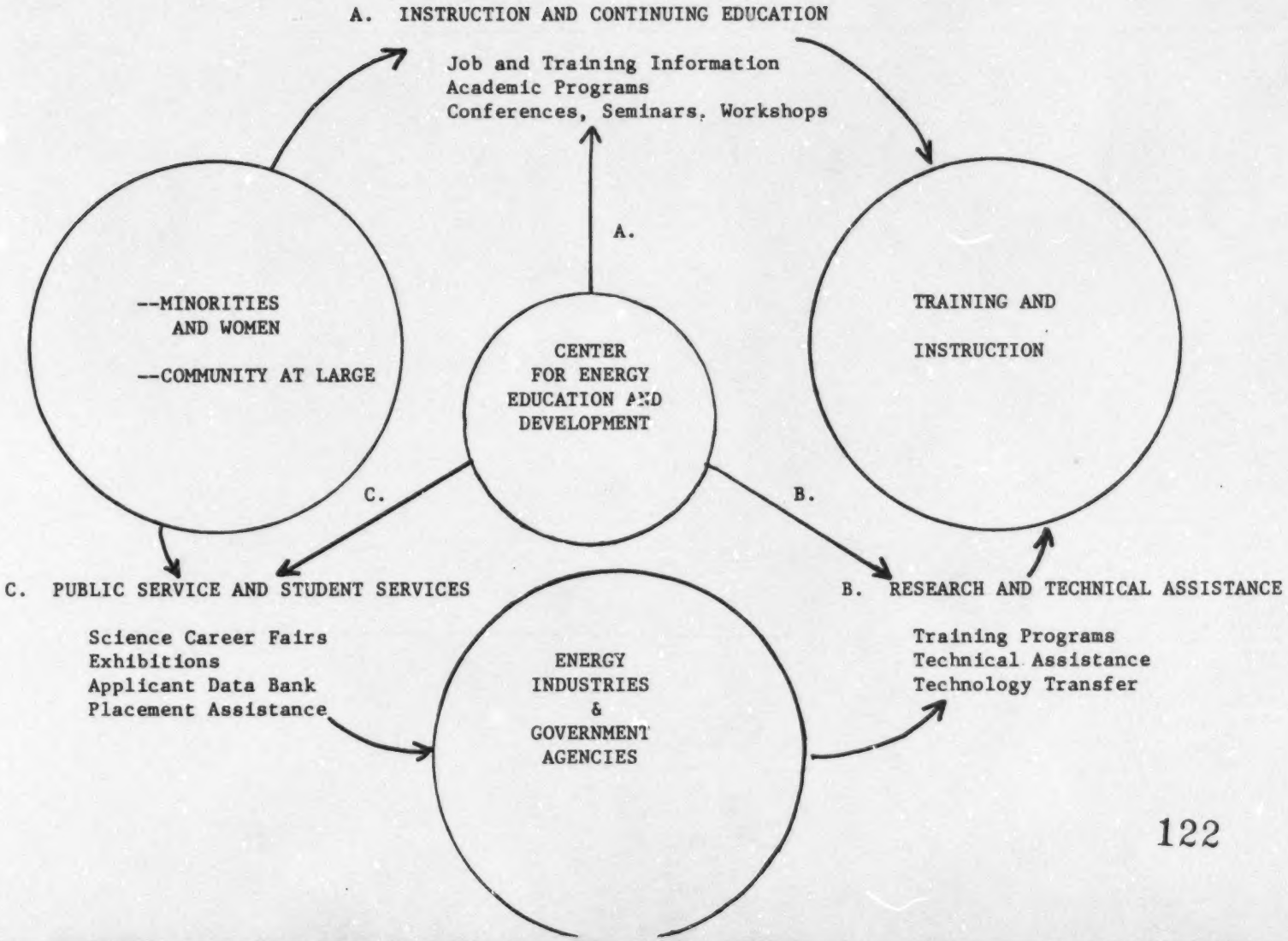
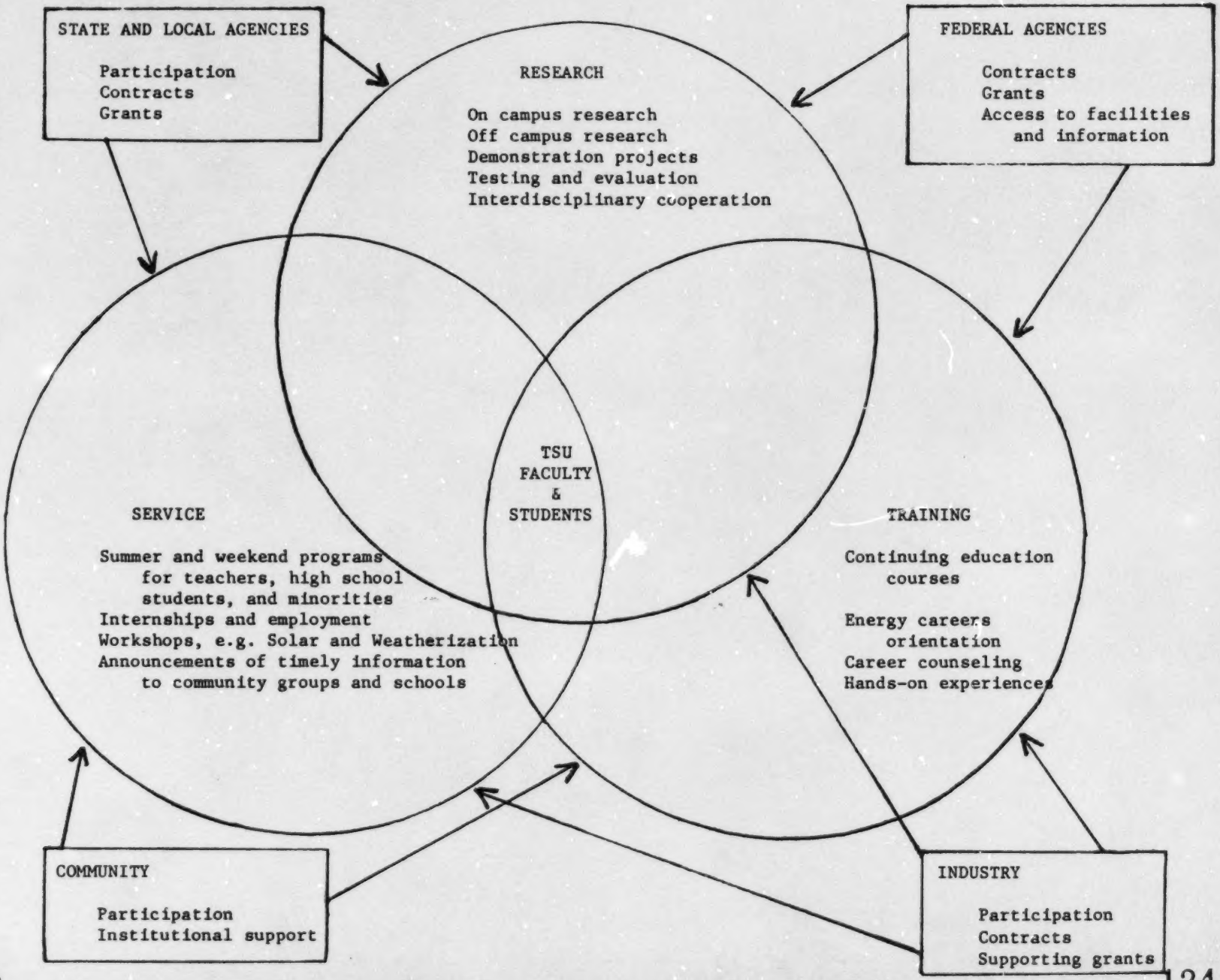


DIAGRAM 3


STATE AND LOCAL AGENCIES
Participation
Contracts
Grants
FEDERAL AGENCIES
Contracts
Grants
Access to facilities and information
RESEARCH
On campus research
Off campus research
Demonstration projects
Testing and evaluation
Interdisciplinary cooperation
TSU FACULTY & STUDENTS
SERVICE
Summer and weekend programs for teachers, high school students, and minorities
Internships and employment
Workshops, e.g. Solar and Weatherization
Announcements of timely information to community groups and schools
TRAINING
Continuing education courses
Energy careers orientation
Career counseling
Hands-on experiences
COMMUNITY
Participation
Institutional support
INDUSTRY
Participation
Contracts
Supporting grants

The Center for Energy Education and Development will enhance the development of activities in energy instruction, research, and service. The Center will provide a balanced approach to meet the goals of all three mission areas of the University without sacrificing or neglecting any one of them. Each year the Center will plan specific activities to achieve the relevant sub-goals of instruction, research, and service.

As a unit within the Division of Continuing Education, Extension, and Public Service, the Center for Energy Education and Development will report to the Office of the Vice-President for Continuing Education. Through that office the Center will communicate with the offices of the other vice-presidents and the administrative or academic units that report to them. An ad-hoc arrangement for programmatic reporting to all the involved officials will be developed for the duration of each joint project, such as the currently proposed program to involve School of Business students in the management of petroleum service stations and to involve the School of Engineering in research on leakage from underground gasoline storage tanks.

A faculty advisory committee will maintain an on-going, active dialogue among the different schools involved in energy-related activities. Members of the committee will be appointed by the various Deans and will serve as liaisons between each of the Schools and the Center. They will provide the Center with information about on-going or

planned activities of energy-related research, training, or public service in their areas. They will also share knowledge of the capacity or interest of their colleagues to conduct energy-related projects. In this way, the advisory committee will help the different schools make the most out of the talent and expertise that is available on campus. The committee may also serve to encourage faculty participation in the various activities that will be initiated and carried out under the auspices of the Center. As illustrated in Diagram No.1, the interaction and the relationships between the Center and the various administrative and academic units on Campus will fall into one of three categories:

a.Direct responsibility--for projects and activities that will be carried out as part of the Center activities with the advice of a Steering Committee composed of appointed government, industry, and community representatives.

b. Information exchange and coordination through a Faculty Advisory Committee and through direct contacts with the Office of Research and Development, Student Affairs, Business Affairs, and other administrative offices. Such activites will supplement and parallel the regular communication between the different offices and schools to facilitate adequate response to emerging opportunities.

c. Joint projects--with a particular School, Department, or University Office for carrying out a project or activity of mutual interest.

Contingent on the availability of additional outside funding support, the Center will initially consist of a part-time director who holds a regular academic appointment, a part-time assistant and a full-time secretary. The exact amount of funding that will be allocated for the Center's management will depend upon the scope of the planned activities of the Center for a given semester or program year. It is expected that the Center will be self sufficient and seek funding to underwrite its operational expenses through grants and contracts from government agencies as well as from cooperative agreements with energy-related industries and organizations. The Center will negotiate such agreements and allocate such funds in each budget proposal.

A minimum level of support will be guaranteed by the University when outside funding is temporarily unavailable. The Director will receive release time equivalent to one three-hour graduate course per semester for the administration of the Center and the development of funding and cooperative agreement opportunities. This time will be counted as approved public service and research when calculating and evaluating the regular work load in the director's academic school or department. The Division of Continuing Education, Extension, and Public Service will

provide additional administrative and secretarial support as needed.

POSITION PAPER
ON DEVELOPING
COOPERATIVE AGREEMENTS
FOR GRADUATE STUDENTS
WITH ENERGY-RELATED INDUSTRIES

The Energy Education Institute has determined through the Energy Careers Symposium held in February 1984, that there is a need to identify promising students, especially qualified minorities and women who wish to prepare for employment and business careers in the energy industry. They need special programs to help them prepare for such careers. The Energy Education Institute recommends developing cooperative agreements with companies which produce or distribute electricity, gas, oil, coal, or those that operate other energy-related businesses, to provide internships, graduate fellowships, and subsequent employment opportunities for students.

Needs Assessment

The 1980 Census reveals that while college graduates account for 17% of the labor force nationwide, they comprise only 12% of the labor force in Tennessee. Although 56.6% of the Tennessee labor force is employed in manufacturing, trade, services, and mining, which is within one percent of the national average, the state is significantly behind the national average in the percentage of college graduates.

BEST COPY AVAILABLE

The lack of advanced professional education may explain the lower value added per employee rate in Tennessee in comparision with the national figures, as illustrated in the chemical and electrical/electronic industries in the following tables.

1977 EMPLOYMENT AND VALUE ADDED IN THE CHEMICAL INDUSTRY

SIC Group	Product	Tennessee Employment	Tennessee Percent of Sector Employment	Value Added per Employee: Tennessee	Value Added per Employee: United States
281	Industrial gas, chlorine, pigments, inorganic, phosphorous, etc.	17,700	33.4	$56,362	$58,975
282	Plastics, cellulose, synthetic fibers	19,800	37.4	30,419	49,891
283	Drugs	2,800	5.3	58,286	63,554
284	Soap and cosmetics	1,600	3.0	60,250	84,294
285	Paints, lacquers, etc.	600	1.1	20,833	45,950
286	Industrial organic chemicals	6,400	12.1	33,125	84,261
287	Agricultural chemicals and insecticides	1,500	2.8	71,067	70,647
289	Miscellaneous: adhesives, explosives, ink	2,600	4.9	32,731	46,021
	Total Chemicals	53,000	100.0	42,938	54,441

1977 EMPLOYMENT AND VALUE ADDED IN THE ELECTRICAL AND ELECTRONIC INDUSTRY

SIC Group	Product	Tennessee Employment	Tennessee Percent of Sector Employment	Value Added per Employee: Tennessee	Value Added per Employee: United States
361	Transmission equipment and switchgear	1,000	2.6	(D)	28,932
362	Electrical equipment for industry	7,100	18.6	26,366	28,297
363	Household appliances	12,200	32.0	23,402	32,509
364	Lighting and wiring	3,500	9.2	35,286	28,735
365	Radio, TV and phonograph	4,400	11.5	31,636	31,506
366	Communications transmitters and equipment	4,500	11.8	(D)	30,818
367	Electronic components	2,700	7.1	15,852	24,791
369	Miscellaneous: batteries, circuit boards, wiring devices	2,700	7.1	20,444	32,352
36	Total Electrical and Electronic	38,100	100.0	25,039	29,230

(D) Data for these sectors was undisclosed in the *1977 Census of Manufactures*. Employment figures for these two sectors were estimated from the *Tennessee Directory of Manufactures, 1978*.

Source: *1977 Censuses of Manufactures.*

Taken from Survey of Business
The University of Tennessee
Summer, 1983, Vol 19, No. 1

In December 1982 the Governor's Job Skills Task Force released a report entitled Meeting Future Job Skills Requirements in Tennessee, The report identified the following areas as ones which will be required in Tennessee by 1990:

1. Engineering, electronic, automation specialists, mechanical technical training
2. Computer programmers, technicians, systems analysts, machine control specialists
3. Computer literacy and computer logic training
4. Data processing, typing skills and terminal manipulation skills
5. Computer assisted design and drafting training
6. Improved oral and written communication skills
7. Improved reading comprehension
8. Improved math, quantitative and science skills, and problem solving skills
9. Interpersonal skills such as listening, critiquing, meeting, tolerating, and managing employees
10. Business economics and decision making knowledge
11. Electronic skills
12. High quality technically trained educators and educators with business experience
13. Technical training in health related occupations
14. Multi-skilled craftsmen and mechanics
15. Financial managers
16. Transportation system knowledge
17. Small business management skills
18. Basic electronics keyed toward understanding mechanics of automated equipment
19. Electronic and computer maintenance

SOURCE: Jobs Skills Task Force Regional Meetings held in Knoxville, Nashville, and Memphis, Tennessee, July, 1982.
NOTE: Not listed in order of importance.

The state's Office of Employment Security projects a 21% increase in the number of openings for individuals with advanced degrees in chemistry, 19% for electrical engineers, 23% for social scientists, and 19% for managers and personnel experts, as well as a growth of 37% for financial analysts.

The potential growth and employment in the energy industry is well illustrated by the projected increase of energy consumption in the state which will average 100% increase over the 1980 consumption by 1989. The state's vigorous efforts through its Department of Economic and Community Development may provide new employment opportunities for aspiring minorities and females in addition to this expected growth. Even a conservative estimate of 0.5% increase in the size of the labor force within Tennessee from 1980 to 1990 may generate up to 1000 new jobs. With adequate preparation, minority students may be able to take advantage of such employment opportunties.

The U.S. Department of Energy recognized the need to foster and enhance the careers of minorities and females in the energy industry through a contract provided the Energy Education Institute of TSU to plan and develop such learning opportunities through the University's graduate and undergraduate programs. During Phase I of this project, we found that minorities and females experience difficulty in career mobility and employment in the energy industry because they lack the advanced skills in demand by

prospective employers. Graduate fellowships would provide the means necessary for these students to pursue the advanced studies to prepare for these careers. Internships would permit the hands-on experience so valuable in career preparation.

Organization and Administration

The Energy Education Institute will promote the value of preparing for energy-related careers through the various schools and in cooperation with the various coordinators of the graduate programs on campus. The Institute will aim to identify highly motivated minorities and females and to develop their interest in business or professional careers in the energy industry. The Institute, through its other outreach activities, will make a special effort to assist the different graduate programs in recruiting minorities and women to the graduate programs in the social sciences, engineering, and business, but will not become involved in the admission process. Typically, after admission to the graduate school and the departmental program, the student would apply for a fellowship for the graduate studies. The director of the Energy Education Institute would advise the student, in addition to the regular academic advisor, to help the student prepare for practicums or internship experiences with energy-related companies or agencies, as well as for job applications and interviews. The director

of the Institute will maintain the working relations already established with companies in the University's Cluster program and those that have become involved with TSU in connection with the various activities of the Energy Education Institute to provide the internships and practicum experiences.

Each student will pursue a prescribed course of study and will comply with the department's and the school's requirements for graduation. The director of the Institute, in conjunction with the departmental advisor, will direct the student to those elective courses most likely to be instrumental for employment in the energy industry. For example,a student that is working on an MBA will be advised to take a course on government regulation which is usually part of the MPA program. A student in chemistry will be encouraged to take a course in industrial decision making in engineering or a course in marketing or accounting in the School of Business. In addition, students awarded fellowships would become involved in the various projects of the Energy Education Institute to obtain first hand knowledge about selected aspects of energy production, utilization, and regulation. These activities will enrich the student's program of studies with courses that are relevant to the business, engineering, and government regulation aspects of energy enterprises. Internships will make these minority and female graduates more attractive to prospective employers in the energy industry.

ENERGY EDUCATION CONSORTIUM

A POSITION PAPER

During Phase I of the Cooperative Developmental Energy Project at Tennessee State University, the Steering Committee suggested that the Energy Education Institute study the possibility of facilitating the formation of a consortium of energy-related utilities within the state of Tennessee to offer combined training opportunities, which might also serve as learning experiences for the minority and female students involved in the other projects with the Energy Education Institute. In order to explore the feasibility of such a consortium and to share ideas for how such a plan could work, a preliminary planning luncheon meeting was held on July 17, 1984. Representatives from electric, gas, and oil utilities were invited to participate in the discussion of training in their own operations and how this might be improved by offering joint training opportunities. In attendance at that meeting were: J. H. Wenberg of Nashville Gas, Tom Bell of Nashville Electric Service, Dean Martin and Joe Caudle of United Cities Gas, Joyce Blackmon and Barbara Bailey of Memphis Light, Gas, and Water, Allan Ralls of the Tennessee Gas Association, Ed Oliver of Clarksville Electric, W. R. Holland of Cookeville Electric, Larry Kirk of Murfreesboro Electric, A. Halachmi, Director of the Energy Education Institute, Ed Cullum of Tennessee State University, and John Crothers,

Vice President at Tennessee State University and Director of the Tennessee's High Technology Development Project. This position paper summarizes the discussions of that meeting.

The training activities of companies and other energy-related organizations in the energy industry are influenced by the type of ownership (i.e. private, public, cooperative, or any combination); the product (i.e. electricity, gas, oil, coal, solar, etc.) or the relative market function (i.e. generation/production, distribution, service). Regardless of ownership type, product characteristics, marketing function, or company size, most of the organizations provide their employees with some extent of training. Training activities may vary greatly in proportion to the size of the staff. A large company, with thousands of employees may staff an entire training division with as many as forty trainers, while a small company with only 10 or 15 employees may rely mostly on on-the-job experiences and offer little formal training. In all cases, however, there is some training that is similar to the training offered by other organizations in the field.

The training activities involving efforts to develop and improve the administrative, supervisory, and interpersonal skills and to facilitate the personal and professional growth of employees is the most often duplicated. Much of this training is done in-house, either by company employees or by outside instructors. It has been observed that, in addition to the expected training

benefits, in-house training opportunities facilitate and contribute to the development of group spirit and thus to the overall moral of employees.

In-house training has some drawbacks, however. First, it may encourage tunnel vision, helping to mold employees to follow the same pattern of thinking. This corporate mentality can be very useful under positive conditions, but it also can have serious disadvantages in negative situations. A unified pattern of thinking may interfere with the organization's ability to rapidly identify necessary changes which need to be made in the internal or external environments of the organization for important strategic planning. Second, in-house training may be perceived by some employees as just another work-related activity. These employees may not view in-house training as a reward for performance or a recognition of potential, which could be the case with external training experiences. Third, in order to run cost-effective training programs, an entire group of 10 or 15 employees might be needed for each course. Many organizations may not be in a position to remove so many employees at the same time from the job. Or they may not have enough employees ready for a particular course, such as supervisory training. Rather than wait months, or even years, for such a course to be available within the company, the employees could be sent to another company, or to a course offered in conjunction with one of the higher education institutions in the state. The

personnel could receive the training needed at the time it would be most beneficial to the company, without the expense of the company running its own course. For these reasons, it make sense to explore the possibility of developing some kind of cooperation among interested organizations who want to maintain the advantages of some in-house training, while eliminating its disadvantages by offering some courses through a consortium effort.

A consortium of energy-related organizations could share information about the training activities they have already planned within each organization. They can distribute to others in the consortium listings of these programs, to which others would be invited to attend at cost. Together, these organizations could also plan joint activities to fill training needs in areas of common interest which have previously been unfilled, such as special accounting procedures for utilities, often needed for new accounting employees. Consortium participants might send one or two employees to participate in a training activity offered by another organization, without having to fill a class of 10 or 15 by themselves. Joint efforts might feature the sharing of renown outside consultants, previously impossible for any one organization to provide solely for its employees. Working with the Energy Education Institute at Tennessee State University would put participants in contact with the entire state network of colleges and universities. These educational institutions

or other training facilities could be contracted to provide a custom-tailored program to meet the special needs of a group within the consortium. Employees of the participating organizations could also assist other companies with their in-house training, at a cost much lower than the going rate for outside trainers. Companies could share curriculum, materials, and facilities for hands-on training experiences.

Such a training consortium could help energy-related organizations make much more efficient use of the resources earmarked for training. It might also provide them with an opportunity to contribute to positive feelings and enhance the sense of professionalism among the employees, providing them the opportunity to meet other professionals. Organizations that are not large enough to develop their own in-house training programs would have an opportunity to offer such programs to their employees, capitalizing on and benefiting from these joint efforts. The resources and experiences of other organizations within the industry would be shared with those who could not otherwise provide such training, benefiting both the state's economy and the industry.

The Energy Education Institute of Tennessee State University would help facilitate the development of such a consortium by serving as host until other arrangements are made. A task force of representatives from various energy-related organizations would be formed to direct the actitivites for the consortium. Several participants in the

July 17th meeting agreed to serve on such a task force. They also agreed that the first activity should be to distribute this position paper to all the energy-related companies in the state. In addition, companies would be asked to respond to a request to send information about local training activities planned between September and December of 1984. Such a response would signify that a company is interested in joining the consortium. This information will then be compiled into a newsletter and distributed to all the companies. Later, the consortium task force would determine what additional consortium courses could be offered to fill other training needs. In exchange for its role as facilitator, the Energy Education Institute would select one or two qualified TSU students to participate in these training programs, helping them to become better prepared for internships, summer work programs, and future employment with energy-related organizations.

CENTER FOR ENERGY EDUCATION AND DEVELOPMENT

CONCEPTUAL FRAMEWORK

FOR A PROJECT

TO PLAN, DEVELOP AND OPERATE

A TEST FACILITY

FOR ENERGY-RELATED PRODUCTS

DR. JACK A. THOMAS

PROJECT DIRECTOR

PROJECT FOR THE PLANNING AND OPERATION OF A TESTING FACILITY FOR ENERGY-RELATED PRODUCTS

A CONCEPT PAPER

PROPOSAL: To plan, design, "build", market and operate a standardized testing facility to examine and test energy-management products for manufacturers, purchasers, organizations and governmental agencies.

ESTIMATED COST: The cost for the two-year project has been estimated to be:

First Year -- $469,105

Second Year -- $810,010.

BASIS OF NEED: There are over 250 firms that manufacture and/or assemble energy saving equipment suitable for residential, light commercial, governmental and institutional uses. Products sold by these manufacturers are engineered, installed and/or serviced by approximately 41,000 dealers across the nation. Most products sold by these dealers have been tested "in-house" by the respective manufacturer while a limited number have been examined and tested by "outside" groups such as Bennett Laboratories, Inc. of Tacoma, Washington, Purdue University, the National Gas Association and Harold B. Eason Engineering of Decatur, Georgia.

Such testing is expensive, often lacks a degree of uniformity and may require months or years to schedule in the limited number of testing facilities. While some manufacturers have contemplated building their own test facilities to surmount these problems, others have determined that they cannot afford large cash outlays for such "non-productive" capabilities.

Hence, there appears to be a need for a "state of the art" facility to standardize the testing of energy management equipment and systems for residential and light commercial, governmental and

institutional uses. Such a facility would facilitate the creation of a common standard for testing and reporting for the energy management industry. Also, the establishment of such a facility, which will be affiliated with the University, will provide easy access to small and minority businesses that are trying to enter the market with new products but cannot afford to develop their own testing facility.

Since approximately 36 percent of the nation's commercial buildings are in the "South", it would appear that Nashville would be a convenient marketing center for such a service.

Preliminary research indicates that there is a limited number, perhaps only two or three, dedicated, instrumented test "houses" where manufacturers and others from the private sector may take their energy management equipment and systems for testing in a controlled, standardized environment.

APPROACH: The development of the project will be included as a major activity of the Center for Energy Education and Development at Tennessee State University. In consultation with the U. S. Department of Energy, the Oak Ridge National Laboratories and the Tennessee Valley Authority, the project director will develop detailed proposals to secure funding for the first two (2) years of the project. It is expected that after a two (2) year incubation period, the project will make the transition to financial self-sufficiency as a not-for-profit organization operating in the private sector. Such an organization will, however, maintain close, functional ties to the University.

The project director will hold a faculty appointment in the School of Business and will coordinate and supervise the involvement and contributions of faculty and students from the School of Business and the School of Engineering. The terms of the dedicated appointment will be negotiated and handled by the School of Business pending the approval of the grant proposal(s) for financing the project.

For reporting purposes and accountability, the project will be administratively housed in the Center for Energy Education and Development. However, it is recommended that its day-to-day operation be included as an integral part of the TSU-TVA Small Business Incubation Center. During the third year, it will make the transition into the not-for-profit corporation. The not-for-profit corporation will remain affiliated with the University through the Center for Energy Education and Development in order to facilitate further research, development and training for minority faculty and students.

The project director will develop a comprehensive proposal within thirty (30) days after the University is informed by DOE about the approval, in principle, of this concept paper for possible funding. The project cost for the first two (2) years, until the operation moves into the self-sufficient phase is estimated at $1,279,115.

RESEARCH COMPONENTS

ASSOCIATED WITH

THE PROPOSED ENERGY TEST FACILITY

GRANT PROPOSAL

The following publishable research components are contemplated as resulting from the proposed energy equipment and systems test facility grant submitted by Tennessee State University to the U. S. Department of Energy:

School of Business

- Review of the literature relative to the energy test facility concept and the procedures to be used in operating such a facility.
- Survey of existing test facilities (three installations shall be visited by a three member project team -- U. S. Bureau of Standards, National Association of Home Builders, and the American Gas Association).
- Survey of manufacturers of energy saving and energy management equipment and systems.
- Development of a marketing program using upper-level students majoring in Business.
- Delineation of a business structure applicable to moving the test facility from the Small Business Incubation Center to the private sector.
- Development of a long-range business plan for the test center which includes MBO's related to the developmental, demonstration and stand-alone phases of the project.
- Development of a financial plan which moves the test center and operation from the public to the private sector.
- Examination of the tax consequences of a stand-alone test facility and operation as they relate to members of minority groups.
- Development of a quarterly publication to publish the results of the testing program.
- Development of a functional accounting and financial reporting system for the test center and operation.

School of Engineering and Technology

- Review of the literature relative to the technical aspects of existing test facilities and the technical operating requirements associated with such facilities.
- Survey of existing test facilities (three installations shall be visited by a three-member project team -- U. S. Bureau of Standards, National Association of Home Builders, and the American Gas Association).
- Integration of the business requirements into spacial needs for the test facility using data secured from existing test facilities.
- Develop the preliminary architectural specifications for the test structure.
- Develop the preliminary heating and cooling and air handling specifications for the test facility.
- Develop the preliminary specifications for the instrumentation of the structure.
- Combine the preliminary architectural, heating, cooling, air handling and instrumentation specifications into an integrated facility design.
- Review the integrated facility design with officials of the U. S. Department of Energy, the National Bureau of Standards and representatives from the private sector.
- Refine the facility design and publish the final specifications.
- Develop the technical aspects of bid proposals for: the structure; heating, cooling and air handling; and instrumentation.
- Review bid responses for: the structure; heating, cooling and air handling; and instrumentation.
- Review the contracts for: the structure; heating, cooling and air handling; and instrumentation.
- Develop and implement a quality assurance program for the construction and equipping of the test facility and render a final report relative to the acceptability of the completed project or phases of the project.